The

British Mycological Society.

(Recognosce notum, ignotum inspice.)

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British Mycological Society.

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68. Ogle, Mr. B. S., Hill House, Steeple Aston, Oxon.
69. Oke, Mr. Alfred William, B.A., L.L.M., F.G.S., F.L.S., 32, Denmark Road, Hove.
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86. Rea, Mrs. Emma Amy, 34, Foregate Street, Worcester.
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88. Selborne, The, Society, 42, Bloomsbury Square, London, W.C.
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93. Smith, Miss Annie Lorrain, F.L.S., 20, Talgarth Road, West Kensington, S.W.
94. Smith, Mr. Worthington G., 121, High Street, Dunstable.
95. Swanton, Mr. E. W., Brockton, Haslemere.
96. Tatum, Mr. E. J., Salisbury.
97. Taylor, Miss Adelaide, 85, Eltham Road, Lee, Kent.

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Yearly Subscription.

7. All Ordinary Members and Clubs shall pay an annual subscription of 10/- and Foundation Members 5/-, and the same shall be due by the First of January in each year, whilst Honorary Members shall be exempt from any annual subscription. Any Member wishing to retire from the Society shall give notice to the Hon. Secretary in writing before 1st of December of the previous year, otherwise he shall be liable for the annual subscription for the next year.

Government of the Society.

8. The management of the British Mycological Society shall be vested in the President, Vice-President, Treasurer, and Hon. Secretary.

Election of Officers.

9. The President, Vice-President, Treasurer, and Hon. Secretary shall be elected annually, at the first meeting of the British Mycological Society in each year, by a majority of the Members then present.

Meetings or Forays.

10. The British Mycological Society shall hold one or more meetings annually at a place and time determined by the Members at the previous meeting, or in default thereof, by the President, Vice-President, Treasurer, and Secretary. Invitations from Local Societies shall be first entertained and the acceptance of such shall imply that the Local Society undertakes to arrange the excursions of the foray, obtain necessary permissions from landowners, and place at the disposal of the British Mycological Society a room, free of cost, for the exhibition of specimens, delivery of addresses, and the transaction of business.

RULES.

Society's name and objects.

1. The Society shall be called "The British Mycological Society," and its objects shall be the study of Mycology in all its branches, systematic, morphological and pathological, the publication of annual reports recording all recent discoveries in any branch of mycology, and more especially giving a brief synopsis of the work of European Mycologists and the recent additions to the British Fungus Flora.

Members of Society.

2. The Society shall consist of Foundation Members, Honorary Members and Ordinary Members, the number of Foundation Members shall be limited to 100 and that of Honorary Members to 20, but the number of Ordinary Members shall be unlimited.

Foundation Members.

3. Foundation Members shall consist of those Members and Clubs who joined the Society previous to the limit of 100 Members of the Society having been attained, but after this number has been attained no Person or Club shall be admitted as a Foundation Member.*

Honorary Members.

4. Honorary Members shall be Ladies or Gentlemen of pre-eminence in Mycology, or who have rendered special service to the Society.

Ordinary Members.

5. Ordinary Members shall be Ladies or Gentlemen elected as hereinafter set out.

Election of Members.

6. Until the limit of 100 Foundation Members be reached* any person or Club may signify their desire of joining the British Mycological Society and will consequently be enrolled as Members thereof by the Secretary. Honorary Members shall only be elected at a meeting of The British Mycological Society by the majority of the Members then present. Ordi-

* The limit of 100 Foundation Members was reached 22nd October, 1903.

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APPENDIX.

Form of proposal for Ordinary Membership of the British Mycological Society.

____

*of*______________________________________

____

being desirous of becoming an Ordinary Member of the British Mycological Society, we, the undersigned Members of the Society, certify that we consider h   to be a desirable Member of the Society, and beg to recommend h   for election.

Dated this   day of   19

________________________(From personal knowledge).

Certificate to be signed by the Candidate.

I hereby certify that I desire to become an Ordinary Member of the British Mycological Society and that I will abide by the Rules if elected.

____

THE WORCESTER SPRING FORAY.

24th to 28th May, 1912.

The fourth informal spring foray of the British Mycological Society was held at Worcester from Friday, the 24th of May, to Tuesday, the 28th of May, 1912. The Committee of the Library and Museum very kindly placed the Committee Room and Art Gallery of the Victoria Institute, Worcester, at their disposal, and this constituted the headquarters of the Society for the spring foray. Here the members assembled on the afternoon of Friday, the 24th of May. On the walls of the Art Gallery were exhibited thirteen hundred and sixty-eight original water colour paintings of fungi by Mrs. Carleton Rea. These were the result of twenty-four years' study and include ninety-nine additions to the British Fungus Flora and thirty-six new to Science. The following were the additions to the British Fungus Flora:—*Amanita aureola* Kalchbr., *Lepiota alba* Bres., *pratensis* (Bull.) Fr., *submarasmioides* Speg., *nympharum* Kalchbr., *irrorata** Quél.; *Tricholoma squarrulosum** Bres., *triste* Fr., *glaucocanum* Bres., *sordidum* Fr. var. *lilaceum* Quél.; *Clitocybe comitialis* Fr., *viridis* (With.) Fr.; *Collybia retigera** Bres., *longipes* (Bull.) Berk. var. *badia* Lucand, *dryophila* (Bull.) Fr. var. *funicularis* Fr., *mephitica** Fr., *Mycena rubella* Quél., *virens** (Bull.) Quél., *umbellifera* (Schaeff.) Fr.; *Omphalia umbellifera* (Linn.) Fr. var. *myochroa* Fr., *velutina** Quél., *gracilis** Quél.; *Pleurotus decorus** Fr.; *Pluteus hispidulus* Fr., *pellitus* Fr. var. *punctillifer* Quél.; *Entoloma erophilum* Fr.; *Nolanea versatilis** Fr., *araneosa** Quél., *papillata* Bres., *exilis** Fr.; *Inocybe proximella** Karst., *praetervisa** Quél., *Gaillardii* Gill., *fulvella** Bres., *corydalina** Quél., *Godeyi** Gill., *brunnea** Quél., *hirsuta* Lasch; *Hebeloma sacchariolens* Quél.; *Naucoria effugiens* Quél.; *Galera spicula* (Lasch) Fr., *Sahleri** Quél.; *Psaliota Bernardii** Quél., *exserta** (Viv.) Rea, *xanthoderma* Genév., *flavescens** Roze, *perrara* Schultz.; *Hypholoma melantinum* Fr., *Coprinus squamosus* Morg., *bulbillosus** Pat., *Patouillardii** Quél.; *Cortinarius (Inoloma) argutus* Fr.;

* The names of the paintings marked with an asterisk have been published as plates in the Transactions of the British Mycological Society.

*Hygrophorus pustulatus** (Pers.) Fr.; *Lactarius fluens** Boud., *spinosulus** Quél.; *Russula sardonia* (Fr.) Bres., *rubra* (Krombh.) Bres., *grisea** (Pers.) Fr.; *Cantharellus amethysteus** Quél.; *Marasmius globularis** (Weinm.) Quél.; *Panus rudis* Fr.; *Boletus sphaerocephalus* Barla, *pinicola* (Vitt.) Rea, *candicans* Fr., *reticulatus* (Schaeff.) Boud., *nigrescens** Roze & Richon, *rugosus* Fr.; *Polyporus flavovirens* Berk. & Rav., *arcularius** (Batsch) Fr., *benzoinus** Fr.; *Fomes trabeus* Rostk., *resinaceus* (Boud.) Rea; *Polystictus Montagnei** Fr., *albidus* (Trog) Fr., *nodulosus** Fr.; *Poria placenta* Fr.; *Trametes rubescens** (A. & S.) Fr.; *Merulius Guillemotii* Boud.; *Hydnum Queletii* Fr.; *Odontia alliacea* Weinm.; *Helicobasidium purpureum** Pat.; *Craterellus pusillus** Fr.; *Clavaria striata* (Pers.) Fr., *dissipabilis* Britz., *subtilis* (Pers.) Fr.; *Femsjonia luteoalba* Fr.; *Lycoperdon velatum** Vitt., *depressum** Bon., *umbrinum* Pers.; *Bovistella paludosa** Lév.; *Lysurus australiensis** Cke. & Mass.; *Scleroderris bacillifera** (Karst.) Sacc.; *Mollisia ramealis* Karst.; *Corynella glabrovirens* Boud.; *Dasyscypha flavo-fuliginea* (A. & S.) Fckl.; *Galactinia ampelina**(Quél.) Boud.; *Verpa Krombholtzii* (Cda.) Boud.; *Cudonia confusa** Bres. and *Mitrula sclerotipus* Boud.

Those new to Science were *Schulzeria Grangei** Eyre; *Tricholoma horribile** Rea, *luteocitrinum** Rea; *Collybia eriocephala* Rea; *Mycena carneosanguinea* Rea, *Iris* Berk. var. *caerulea* Rea; *Omphalia Allenii** Maire; *Chlorospora Eyrei* Mass.; *Entoloma griseocyaneum* Fr. var. *roseum** Maire, *pulvereum** Rea; *Leptonia Reae** Maire, *serrulata* (Pers.) Fr. var. *Berkeleyi* Maire; *Pholiota grandis* Rea; *Inocybe duriuscula** Rea, *haemacta* Berk. & Cke. var. *rubra* Rea; *Flammula rubicundula* Rea; *Coprinus roseotinctus* Rea, *cordisporus* Gibbs; *Cortinarius (Phlegmacium) turbinatus* Fr. var. *lutescens* Rea; *Hygrophorus discoxanthus** Rea, *squamulosus* Rea, *citrina** Rea, *Reai** Maire; *Russula mitis* Rea; *Marasmius archyropus* Fr. var. *suaveolens** Rea; *Androsaceus epiphylloides** Rea; *Polyporus sulphureus* Fr. var. *albolabyrinthiporus* Rea; *Poria Eyrei** Bres.; *Hydnopsis farinacea** (Pers.) Rea; *Clavaria conchyliata** Allen, *luteoalba** Rea, *straminea** Cotton, *Michelii* Rea; *Phaeotremella pseudofoliacea** Rea; *Helotium chloropodium** Rea & Ellis and *tetraascosporum* Rea.

In the evening the following fungi were placed out on exhibition in the committee room:—*Oomyces carneoalbus* (Lib.) B. & Br. sent by Mr. James Menzies from the neighbourhood of Perth. *Taphrina rhizophora* Johanson on catkins of Populus

* The names of the paintings marked with an asterisk have been published as plates in the Transactions of the British Mycological Society.

alba forwarded to Mr. A. D. Cotton by Miss E. Armitage, of Ross, Herefordshire. *Aecidium punctatum* Pers. (=*Puccinia pruni-spinosae* Pers.) on leaves of Anemone coronaria brought by Mr. Norman G. Hadden from his garden at St. Audreys, Priory Road, Malvern; he also produced from that vicinity some specimens of *Pleurotus ostreatus* (Jacq.) Fr., and of *Ustilago tragopogi* (Pers.) Schröt. parasitic on the flower heads of Tragopogon minor. *Clitocybe cerussata* Fr. gathered by Miss C. A. Cooper at Nuneaton. *Melampsorella symphyti* (DC.) Bubak on leaves of Symphytum officinale, and *Psaliota exserta* (Viv.) Rea, both collected by the Hon. Secretary near the side of the river Severn between Kempsey and Severn Stoke, he also exhibited from Malvern some leaves of Amygdalus communis very badly distorted by the parasitic fungus *Exoascus deformans* (Berk.) Fckl.

On Saturday, the 25th of May, the members motored from the headquarters at ten o'clock to Shrawley Wood. The portion of the wood adjacent to a series of pretty pools was carefully searched and a fair number of fungi and mycetozoa were obtained. The most interesting find of the day was made by Mrs. Carleton Rea, who discovered a subterranean fungus which happened to be accidentally exposed on the surface of the ground; some more specimens were obtained in situ by diligently scratching the sandy soil. This was subsequently determined to be *Hysterangium nephriticum* Berk., but the spores are small, measuring $10\text{-}12 \times 4\mu$ instead of $19\text{-}20 \times 5\text{-}6\mu$, the size given for them by Massee in his Monograph of British Gastromycetes, p. 38. Other specimens worthy of note were *Phlebia vaga* Fr. (considered by Quélet to be a form of *Coniophora sulphurea* (Pers.) Quél.), *Odontia fimbriata* (Pers.) Fr., *Puccinia aegopodii* (Schm.) Mart., *Frankiella alni* (Wor.) Maire, *Ciliaria (=Sphaerospora) confusa* (Cke.) Boud., *Hypocrea fungicola* Karst and *Trichia scabra* Rost. Mr. and Mrs. J. H. Allan kindly entertained the members to a welcome cup of tea at The Wood House, after which the members returned to Worcester. In the evening at a business meeting it was resolved that the Whitsuntide week-end spring foray for 1913 should be held at Dolgelly.

The following day the members assembled at the Foregate Station, Worcester, and took return tickets by the 10-18 a.m. train to Malvern Link, from whence a walk across the fields brought them to Brace's Leigh Wood. This wood is a mixture of deciduous and coniferous trees. It yielded specimens of *Naucoria striaepes* Cke., and *Urceolella (=Dasyscypha) papillaris* (Bull.) Boud.; the traverse across the fields produced *Collybia dryophila* (Bull.) Fr. var. *funicularis* Karst. Mr. Norman G. Hadden collected in the wood the mycetozoon

Comatricha pulchella (Bab.) Rost, and Mr. W. B. Allen the var. *fusca* Lister of the same species. Subsequently Dr. J. W. Ellis reported the discovery of an unnamed *Phlyctaena* which he proposed to call *fraxini.**

On Monday, the 27th of May, the members met at the Shrub Hill Railway Station, Worcester, and booked return tickets by the 9-45 a.m. train to Linley. On their arrival at Linley Station at 11-21, Mr. W. B. Allen, who had kindly undertaken to be their conductor for the day, at once led them into the adjoining Caughley Wood. This is a nice damp wood with plenty of fallen timber and rotten branches lying about. These were carefully examined with the result that the following species were secured;—*Odontia fimbriata* (Pers.) Fr., *Diderma effusum* (Schwein.) Morg. and *Dasyscypha diplocarpa* (Curr.) Boud. (=*Diplocarpa Curreyana* Mass.). The description of this last species was emended by Massee and Crossland in The Naturalist for June 1901, on page 182. The spores are continuous and biguttulate, as therein stated, but at maturity they are pale ochraceous and the conidia are of a pale greenish colour. This interesting addition to the list was made by Mr. W. N. Cheesman.

On Tuesday, the 28th of May, the members assembled at the Victoria Institute, Worcester, at 10 a.m., and were conveyed by motors to the north end of Ockeridge Wood. Here the members dispersed in all directions; on subsequently reuniting about one o'clock they found that some interesting things had been collected. Mr. Norman G. Hadden had added the mycetozoon *Enerthenema papillatum* (Pers.) Rost. to the Worcestershire list, and had also gathered some fine examples of *Urnula (=Plectania) melastoma* (Sow.) Boud.; Mr. A. D. Cotton had obtained specimens of *Peniophora hydnoides* Cke. & Mass., *Pulvinula (=Barlaea) constellatio* (B. & Br.) Boud., *Nectria ochracea* Fr., *Acetabula vulgaris* Fckl, and the somewhat rare *Kneiffia setigera* Fr.; Miss C. A. Cooper had boxed a nice mass of *Phaeotremella pseudofoliacea* Rea. The walk was then continued across a few fields to Monk Wood and the return drive taken from Monk Wood Green. In the evening hearty votes of thanks were accorded to the Committee of the Victoria Institute, Worcester, for placing their Art Gallery and Committee rooms at the disposal of the members, and to the Earls of Dudley and Beauchamp and Mr. J. H. Allan for permission to visit their estates and woods.

About three hundred and twenty-five species of fungi and thirty-two species and one variety of mycetozoon were collected during the spring foray. Mr. W. B. Allen and Mr. Norman G.

* See description of this species p. 126.

Hadden were responsible for this latter list, specimens being submitted to our President for confirmation and correction, whilst in the preparation of the list of fungi the Hon. Secretary had the assistance of Dr. J. W. Ellis, Sir Henry C. Hawley, Mr. A. D. Cotton, Miss E. J. Welsford and Mr. J. H. Wheldon.

COMPLETE LIST OF FUNGI GATHERED DURING THE FORAY.

B. Brace's Leigh Wood; *C.* = Caughley Wood; *O.* = Ockeridge Wood; *S.* = Shrawley.

Amanita rubescens (Pers.) Fr. *O.*, *S.*, spissa Fr. *O.*
Amanitopsis vaginata (Bull.) Roze *O.*
Armillaria mellea (Vahl.) Fr. *C.*, *O.*
Tricholoma terreum (Schaeff.) Fr. *B.*
Laccaria laccata (Scop.) Berk. & Br. *O.*, var. tortilis (Bolton) Fr. *O.*
Collybia platyphylla Fr. *O.*, conigena (Pers.) Fr. *B.*, esculenta (Wulf.) Fr. *B.*, tenacella (Pers.) Fr. *B*, dryophila (Bull.) Fr. *C.*, var. funicularis Karst. *Malvern Link*, aquosa (Bull.) Fr. *B.*, *O.*, *S.*
Mycena pura Fr. *B.*, rugosa Fr. *S.*, galericulata (Scop.) Fr. *O.*, *S.*, polygramma (Bull.) Fr. *O.*, *S.*, alcalina Fr. *O.*, ammoniaca Fr. *B.*, amicta Fr. *B.*, acicula (Schaeff.) Fr. *C.*, *O.*, sanguinolenta (A. & S.) Fr. *S.*, stylobates (Pers.) Fr. *S.*, tenerrima Berk. *C.*, discopoda Lév. *C.*, corticola (Schum.) Fr. *C.*
Omphalia fibula (Bull.) Fr. *S.*, var. Swartzii Karst. *S.*
Pleurotus septicus Fr. *O.*, *S.*
Pluteus cervinus (Schaeff.) Fr. *C.*, pellitus (Pers.) Fr. *C.*, chrysophaeus (Schaeff.) Fr. *B.*
Entoloma sinuatum Fr. *O.*, nidorosum Fr. *O.*
Nolanea pascua (Schaeff.) Fr. *B.*, pisciodora (Ces.) Fr. *C.*
Pholiota dura (Bolton) Fr. *C.*, *O.*, praecox (Pers.) Fr. *B.*, *S.*, aegerita (Brig.) Fr. *Monk Wood Green*, mutabilis (Schaeff.) Fr. *C.*, *S.*
Inocybe rimosa (Bull.) Fr. *O.*, eutheles B. & Br. *B.*
Hebeloma elatum (Batsch) Fr. *O.*
Flammula carbonaria Fr. *O.*
Naucoria striaepes Cke. *B.*

Galera tenera (Schaeff.) Fr. *S.*, hypnorum (Schrank) Fr. *S.*
Tubaria furfuracea (Pers.) W. G. Sm. *S.*
Crepidotus alveolus (Lasch) Fr. *C.*, mollis (Schaeff.) Fr. *C.*, *S.*
Psaliota campestris (Linn.) Fr. *B.*, *O.*, xanthoderma Genev. *B.*, *C.*
Stropharia semiglobata (Batsch) Fr. *B.*, *O.*, *S.*
Hypholoma capnoides Fr. *O.*, *S.*, epixanthum (Paul.) Fr. *S.*, fasciculare (Huds.) Fr. *C.*, *O.*, *S.*, velutinum (Pers.) Fr. *S.*, appendiculatum (Bull.) Fr. *B.*, *C.*, *O.*, hydrophilum (Bull.) Fr. *C.*
Psilocybe foenisecii (Pers.) Fr. *C.*
Psathyra corrugis (Pers.) Fr. *O.*, *S.*, fibrillosa (Pers.) Fr. *C.*
Panaeolus campanulatus (Linn.) Fr. *O.*
Psathyrella atomata Fr. *B.*, *O.*, *S.*, disseminata (Pers.) Fr. *S.*
Coprinus atramentarius (Bull.) Fr. *O.*, cinereus Fr. *O.*, niveus (Pers.) Fr. *B.*, *S.*, micaceus (Bull.) Fr. *B.*, radiatus (Bolt.) Pers. *O.*, hemerobius Fr. *O.*
Bolbitius titubans (Bull.) Fr. *C.*
Cortinarius (Telamonia) hinnuleus (Sow.) Fr. *O.*, (Hydrocybe) leucopus (Pers.) Fr. *O.*, *S.*, decipiens (Pers.) Fr. *S.*, acutus (Pers.) Fr. *O.*
Hygrophorus psittacinus (Schaeff.) Fr. *C.*
Lactarius deliciosus (Linn.) Fr. *B.*, subdulcis (Bull.) Fr. *S.*
Russula cyanoxantha (Schaeff.) Fr. *O.*
Marasmius oreades (Bolt.) Fr. *B.*
Panus stypticus (Bull.) Fr. *B.*, *O.*
Lenzites betulina (Linn.) Fr. *O.*
Boletus elegans (Schum.) *B.*, *O.*, granulatus (Linn.) Fr. *B.*, chrysenteron (Bull.) Fr. *O.*, luridus (Schaeff.) Fr. *S.*, laricinus Berk. *O.*, scaber (Bull.) Fr. *S.*
Polyporus brumalis (Pers.) Fr. *C.*, varius (Pers.) Fr. *O.*, elegans (Bull.) Fr. var. nummularius Fr. *O.*, lacteus Fr. *B.*, caesius (Schrad.) Fr. *B.*, adustus (Willd.) Fr. *O.*, *S.*, betulinus (Bull.) Fr.
Fomes annosus Fr. *B.*, *S.*
Polystictus perennis (Linn.) Fr. *O.*, versicolor Fr. *B.*, *C.*, *O.*, *S.*, hirsutus (Schrad.) Fr. *C.*, velutinus (Pers.) Fr. *O.*, abietinus (Pers.) Fr. *S.*
Poria vulgaris Fr. *B.*, *O.*, vaporaria (Pers.) Fr. *S.*
Trametes mollis (Somm.) Fr. *O.*
Daedalea quercina (Linn.) Fr. *O.*
Merulius corium (Pers.) Fr. *B.*
Solenia anomala (Pers.) Fr. *S.*
Hydnum auriscalpium (Linn.) Fr. *B.*, ochraceum Gmel. *S.*, argutum Fr. *C.*
Irpex obliquus (Schrad.) Fr. *B.*, *C.*, *O.*, *S.*
Radulum quercinum (Pers.) Fr. *B.*

Phlebia radiata Fr. *C.*, vaga Fr. *S.*
Grandinia granulosa (Pers.) Fr. *O.*, *S.*, mucida Fr. *C.*, *O.*, *S.*
Odontia fimbriata (Pers.) Fr. *C.*, *S.*
Kneiffia setigera Fr. *O.*
Stereum hirsutum (Willd.) Fr. *B.*, *O.*, *S.*, spadiceum (Pers.) Fr. *C.*, sanguinolentum (A. & S.) Fr. *O.*, rugosum (Pers.) Fr. *B.*, *C.*, *S.*
Hymenochaete rubiginosa (Dicks.) Lév. *C.*, *O.*, corrugata (Fr.) Lév. *B.*, *C.*, *O.*
Corticium lacteum Fr. *O.*, arachnoideum Berk. *O.*, sanguineum Fr. *C.*, caeruleum (Schrad.) Fr. *C.*, *O.*, calceum (Pers.) Fr. *S.*, *O.*, nudum Fr. *S.*, comedens (Nees) Fr. *B.*, serum (Pers.) Fr. *S.*
Peniophora quercina (Pers.) Cke. *B.*, cinerea (Pers.) Cke. *B.*, *O.*, limitata (Fr.) Cke. *B.*, *C.*, *O.*, hydnoides Cke. & Massee *O.*, velutina (DC.) Cke. *O.*, *S.*
Coniophora puteana (Schum.) Fr. *O.*
Cyphella capula (Holm.) Fr. *S.*
Auricularia mesenterica (Dicks.) Fr. *O.*
Hirneola Auricula-judae (Linn.) Fr. *S.*
Exidia recisa Fr. *O.*, glandulosa (Bull.) Fr. *C.*, *O.*, *S.*, albida (Huds.) Bref. *C.*, *S.*
Tremella tubercularia Berk. *B.*, *O.*
Phaeotremella pseudofoliacea Rea *O.*
Dacryomyces deliquescens (Bull.) Duby *S.*, stillatus Nees. *B.*, *C.*
Calocera stricta Fr. *O.*, *S.*
Ithyphallus impudicus (Linn.) Fisch. *C.*
Sphaerobolus stellatus (Tode) Pers. *S.*
Cyathus vernicosus (Bull.) DC. *B.*
Bovista nigrescens Pers. *S.*
Lycoperdon giganteum (Batsch) Pers. *B.*, *S.*
Scleroderma vulgare Hornem. *S.*
Hysterangium nephriticum Berk. *S.*
Melampsora Rostrupii Wagner, *on Mercurialis perennis O.*
Melampsoridium betulinum (Pers.) Kleb. *O.*
Coleosporium senecionis (Pers.) Fr. *S.*, tussilaginis (Pers.) Kleb. *O.*, *S.*
Uromyces ficariae (Schm.) Wint. *S.*
Puccinia violae (Schm.) DC. *O.*, primulae (DC.) Duby *O.*, suaveolens Rostrup *O.*, oblongata (Link) Wint. *S.*, *on Luzula pilosa*, betonicae (A. & S.) DC. *B.*, *C.*, *O.*, aegopodii (Schm.) Mart. *C.*, *S.*, fusca (Pers.) Wint. *S.*, bunii (DC.) Wint. *S.*, malvacearum Mont. *S.*
Phragmidium fragariastri (DC.) Schröter *B.*, *O.*, violaceum (Schultz.) Wint. *O.*, *S.*, rubi (Pers.) Wint. *C.*
Triphragmium ulmariae (Schm.) Link *O.*
Ustilago hypodytes (Schlecht.) Fr., *on Triticum repens B.*

Frankiella alni (Wor.) Maire *S.*
Synchytrium taraxaci de Bary & Woronin *B.*
Pycnochytrium mercurialis (Libert) Schröt. *C.*, *O.*, *S.*
Cystopus candidus (Pers.) Lév. *S.*
Peronospora parasitica (Pers.) Tul. *O.*
Spinellus fusiger (Link) van Tiegh. *C.*, *O.*
Pilaira anomala (Ces.) Schröt. *S.*
Pilobolus crystallinus (Wiggers) Tode. *B.*, *O.*
Empusa muscae F. Cohn *O.*
Protomyces macrosporus Unger, *on Aegopodium Podagraria*, *B.*
Acetabula vulgaris Fckl. *O.*
Aleuria (=Peziza) sepiatra (Cke.) Boud. *C.*
Urnula (=Plectania) melastoma (Sow.) Boud. *O.*
Trichophaea (=Lachnea) gregaria (Rehm) Boud. *S.*
Ciliaria (=Lachnea) umbrata (Fr.) Quél. *S.*, scutellata (Linn.) Quél. *O.*, *S.*
Ciliaria (=Sphaerospora) confusa (Cke.) Boud. *S.*
Coprobia (=Humaria) granulata (Bull.) Boud. *B.*, *O.*, *S.*
Pulvinula (=Barlaea) constellatio (B. & Br.) Boud. *O.*
Ascobolus furfuraceus (Pers.) Fr. *O.*
Cudoniella (=Leotia) acicularis (Bull.) Sacc. *C.*, *O.*
Corynella (=Coryne) atrovirens (Pers.) Boud. *C.*, *O.*, *S.*
Polydesmia (=Belonidium) pruinosum (B. & Br.) Boud. *O.*
Coryne sarcoides (Jacq.) Tul. *O.*
Bulgaria inquinans (Pers.) Fr. *C.*
Calloria fusarioides (B. & Br.) Fr. *S.*
Orbilia leucostigma Fr. *B.*, *C.*, *O.*, *S.*, xanthostigma Fr. *C.*, *O.*, *S.*
Hyalinia rosella (Quél.) Boud. *O.*
Hyalinia (=Orbilia) auricolor (Bloxam) Boud. *O.*
Helotium herbarum (Pers.) Fr. *C.*, *S.*, virgultorum (Vahl.) Karst. *C.*, *O.*, calyculus (Sow.) Berk. *B.*, *C.*, cyathoideum (Bull.) Karst. *C.*, *S.*
Dasyscypha virginea (Batsch) Fckl. *B.*, *O.*, *S.*, nivea (Hedw. fil.) Mass. *C.*, *O.*
Lachnella diplocarpa (Curr.) Boud. (=Diplocarpa Curreyana Mass.), (=Dasyscypha) sulphurea (Pers.) Quél. *S.*
Trichoscypha (=Dasyscypha) calycina (Schum.) Boud. *B.*, *S.*
Arachnopeziza (=Dasyscypha) aranea (de Not.) Boud. *O.*
Hyaloscypha (=Dasyscypha) hyalina (Pers.) Boud. *O.*
Urceolella (=Dasyscypha) papillaris (Bull.) Boud. *B.*
Mollisia cinerea (Batsch) Karst. *B.*, *C.*, *O.*, *S.*, melaleuca (Fr.) Sacc. *O.*
Tapezia fusca (Pers.) Fckl. *O.*
Heterosphaeria patella (Tode) Grev. *B.*, *C.*, *O.*, *S.*
Trochila laurocerasi (Desm.) Fr. *S.*
Propolis faginea (Schrad.) Karst. *S.*
Phacidium multivalve (DC.) Kze & Schmidt *B.*, *C.*

Stegia ilicis Fr. *B.*
Colpoma quercinum (Pers.) Wallr. *B.*, *O.*
Rhytisma acerinum (Pers.) Fr. *S.*
Dichaena quercina (Pers.) Fr. *B.*, *O.*, *S.*
Lophodermium pinastri (Schrad.) Chev., *on fallen pine leaves*, *O.*
Hypoderma conigenum (Pers.) Cke. *B.*, *O.*, virgultorum DC., *on dead Rubus shoots*, *O.*
Mytilidion gemmigenum Fckl., *on Larix*, *C.*
Hysterographium fraxini (Pers.) de Not. *C.*
Gloniopsis curvata (Fr.) Sacc., *on Rosa*, *C.*
Exoascus deformans (Berk.) Fckl., *on Amygdalus communis*, Malvern, turgidus Sadebeck *S.*
Sphaerotheca pannosa (Wallr.) Lév. *B.*
Erysiphe graminis DC. *S.*, communis (Wallr.) Fr. *C.*, *O.*
Penicillium crustaceum (Linn.) Fr. *O.*
Nectria cinnabarina (Tode) Fr. *B.*, *O.*, *S.*, ochracea Fr. *O.*, episphaeria (Tode) Fr. *O.*
Hypomyces rosellus (A. & S.) Tul. *O.*, aurantius (Pers.) Tul. *O.*, *S.*
Hypocrea fungicola Karst. *S.*
Cordyceps militaris (Linn.) Link *C.*, *O.*
Niesslia exilis (A. & S.) Fckl., *on Scirpus sylvaticus*, *O.*
Trichosphaeria barbula (B. & Br.) Wint., *on Pine bark*, *B.*
Leptospora spermoides (Hoffm.) Fckl. *C.*, *O.*, *S.*, ovina (Pers.) Fckl. *C.*, *O.*, *S.*
Rosselinia mammiformis (Pers.) Wint. *O.*, pulveracea (Ehrh.) Fckl. *O.*
Bertia moriformis (Tode) de Not. *B.*, *C.*, *O.*, *S.*
Melanomma pulvispyrius (Pers.) Fckl. *C.*, *S.*, ovoidea (Fr.) Fckl. *O.*
Trematosphaeria melina (B. & Br.) Sacc. *S.*
Sphaerella primulae (Awd. & Heufl.) Wint. *O.*, punctiformis (Pers.) Sacc. *C.*
Laestadia rhodorae Cke., *on leaves and twigs of Rhododendron*, *S.*
Venturia rumicis (Desmaz.) Winter *S.*
Leptosphaeria acuta (Moug. & Nestl.) Karst. *B.*, *C.*, *S.*
Pleospora herbarum (Pers.) Rabh. *C.*
Ophiobolus porphyrogonus (Tode) Sacc. *C.*, acuminatus (Sow.) Duby *C.*, *S.*
Valsa lata (Pers.) Nke. *C.*, *O.*, eunomia (Fr.) *B.*, *S.*, ceratophora Tul., *on Sambucus*, *C.*, millepunctata (Fr.) Nke. *C.*, ambiens (Pers.) Fr., *on branches of Acer*, *C.*
Melanconis stilbostoma (Fr.) Tul. *O.*, *S.*, alni Tul. *C.*
Diatrypella quercina (Pers.) Nke. *B.*, *C.*, *O.*
Diatrype stigma (Hoffm.) de Not. *B.*, *O.*, *S.*

Hypoxylon multiforme Fr. *Monk Wood, O.*, rubiginosum (Pers.) Fr. *O.*, fuscum (Pers.) Fr. *B., C., O., S.*, coccineum (Bull.) Fr. *O., S.*
Daldinia concentrica (Bolt.) Ces. & de Not. *B.*
Ustulina vulgaris Tul. *C., O.*
Xylaria hypoxylon (Linn.) Grev. *B., C., O., S.*
Phyllachora graminis (Pers.) Fckl. *B., O.*, junci (Fr.) Fckl. *O.*
Dothidella betulina (Fr.) Sacc. *B., S.*, ulmi (Duv.) Wint. *B., S.*
Rhopographus pteridis (Sow.) Wint. *C., O., S.*
Phyllosticta mahoniana (Sacc.) Allescher, *on Mahonia, S.*, *primulicola Desm., *on Primula veris, B., S.*
Phoma occulta Sacc., *on cones of Picea excelsa, B.*, scobina Cke., *on Fraxinus excelsior, B.*, sarothamni Sacc. *C., S.*, hysterella Sacc., *on Taxus baccata, S.*, complanata (Tode) Desm., *on dead stems of Angelica sylvestris, O., S.*, strobiligena Desm. var. microspora Sacc., *on cones of Pinus sylvestris, B.*
Macrophoma strobi (B. & Br.) Berl. & Vogl., *on leaves of Pinus austriacus, B.*
Neottiospora caricum Desm., *on Carex pendula, C.*
Cytospora abietis Sacc., *on Larix, S.*, laurocerasi Fckl. *C.*
*Ascochyta primulae Trail *B., S.*, †teretiuscula Sacc. & Roum., *on Luzula, S.*
Stagonospora typhoidearum (Desm.) Sacc., *on Typha, S.*
Septoria primulae Bucknall *B., S.*, rubi Westend. *S.*, violae Westend. *S.*
‡Phlyctaena fraxini J. W. Ellis *B.*
Melanconium sphaeroideum (Link) Sacc. *on Alnus, O.*, bicolor Nees *on Betula, B., C., O.*
Oidium monilioides (Nees) Sacc. *B., O.*, alphitoides Griff. & Maul. *O.*
Trichoderma lignorum (Tode) Harz *S.*
Ovularia obliqua (Cke) Oudemn. *S.*
Sporotrichum flavissimum (Link) Sacc. *O.*
Botrytis cinerea (Pers.) Sacc. var. sclerotiophila Sacc. *O.*
Trichothecium roseum (Link) Fr. *O.*
Diplocladium tenellum (Fr.) Mass. *S.*
Torula monilioides Cda. *O.*
Zygodesmus fuscus Cda. *O., S.*
Cladosporium herbarum (Pers.) Cda., *on Scirpus sylvaticus, S.*
Helminthosporium velutinum (Link) Sacc., exasperatum B. & Br. *O.*
Isaria farinosa (Dicks.) Fr. *O.*
Stysanus Stemonites (Pers.) Cda. *O., S.*

* Both of these are probably only stages of Septoria primulae, J. W. Ellis.
† This is a Septoria, the spores are more than one-septate, J. W. Ellis.
‡For description of this new species see p. 126.

Aegerita candida (Pers.) Grev. *O.*
Tubercularia vulgaris (Tode) Tul. *B.*, *O.*, *S.*
Pionnotes uda (B. & Br.) Sacc. *O.*

List of Mycetozoa.

B. = Brace's Leigh Wood; *C.* = Caughley Wood; *O.* = Ockeridge Wood; *S.* = Shrawley Wood.

Ceratiomyxa fruticulosa (Muell.) Macbr. (syn. C. mucida Schroet.) *B.*, *C.*, *S.*
Badhamia utricularis (Bull.) Berk. *B.*, *O.*, *S.*
panicea (Fr.) Rost. *B.*
Physarum viride (Bull.) Pers. *B.*, *O.*
nutans Pers. *C.*, *O.*, *S.*
Fuligo septica (Linn.) Gmelin *O.*, *S.*
Craterium minutum (Leers) Fr. (syn. C. pedunculatum Trent.) *B.*, *C.*
leucocephalum (Pers.) Ditm. *C.*, *O.*
Diderma effusum (Schwein.) Morg. (syn. Chondrioderma reticulatum Rost.) *C.*
Didymium squamulosum (A. & S.) Fr. (syn. D. effusum Link) *B.*, *C.*, *S.*
Stemonitis fusca Roth. *O.*, *S.*
flavogenita Jahn (syn. S. ferruginea Ehrenb.) *O.*
Comatricha nigra (Pers.) Schroet. (syn. C. obtusata Preuss) *B.*, *C.*, *O.*, *S.*
pulchella (Bab.) Rost. (syn. C. Persoonii Rost.) *B.*,
var. fusca Lister *B.*
typhoides (Bull.) Rost. *O.*
Enerthenema papillatum (Pers.) Rost. (syn. E. elegans Bowm.) *O.*
Reticularia Lycoperdon Bull. *O.*
Lycogala epidendrum (Linn.) Fr. (syn. L. miniatum Pers.) *B.*, *C.*, *O.*, *S.*
Trichia affinis de Bary. *O.*, *S.*
persimilis Karst. *O.*
scabra Rost. *S.*
varia Pers. *B.* *C.*
decipiens (Pers.) Macbr. (syn. T. fallax Pers.) *O.*, *S.*
Botrytis Pers. *B.*
Hemitrichia Vesparium (Batsch) Macbr. (syn. H. rubiformis Pers.) *C.*
clavata (Pers.) Rost. *C.*
Arcyria ferruginea Sauter *S.*
cinerea (Bull.) Pers. (syn. A. albida Pers.) *O.*
denudata (Linn.) Sheldon (syn. A. punicea Pers.) *O.*
incarnata Pers. *O.*
nutans (Bull.) Grev. (syn. A. flava Pers.) *O.*
Perichaena corticalis (Batsch) Rost. (syn. P. populina Fr.) *B.*

THE FORRES FORAY.

JOINT MEETING WITH THE CRYPTOGAMIC SOCIETY OF SCOTLAND.

12th to the 19th September, 1912.

The sixteenth annual week's fungus foray of the British Mycological Society was held at Forres, in conjunction with the Cryptogamic Society of Scotland. The Moray Arms Hotel was constituted the headquarters for the meeting and there the members assembled on Thursday, the 12th of September. Some of the members had arrived at Forres earlier in the week, and their collections of fungi were placed on exhibition in the room reserved for this purpose. These included *Armillaria robusta* (A. & S.) Fr., *Lycoperdon spadiceum* Pers., *Collybia distorta* Fr., *Tricholoma portentosum* Fr., *Paxillus atrotomentosus* (Batsch) Fr., *Pholiota flammans* Fr., *Marasmius foetidus* (Sow.) Fr., *Cortinarius (Telamonia) gentilis* Fr., *Mycena strobilina* (Pers.) Fr., *Inocybe Godeyi* Gillet, and *Boletus rugosus* Fr. Mr. S. R. Price had sent some specimens of *Microglossum viride* (Pers.) Gill. from the neighbourhood of Wellington, Somersetshire. Dr. J. W. Ellis brought *Onygena piligena* Fr. from the Wirral district, and Mr. C. H. Spencer Perceval *Clavaria rosea* Fr. from Morpeth.

On Friday, the 13th of September, the members started in brakes from the headquarters at 9-30 a.m. but it was well past mid-day before they reached Glenferness, distant some twelve miles away. The woods and grounds around Glenferness House were carefully searched and yielded specimens of *Tricholoma lascivum* Fr., *Cortinarius (Phlegmacium) triumphans* Fr., *Cortinarius (Phlegmacium) glaucopus* (Schaeff.) Fr., *Cortinarius (Dermocybe) camurus* Fr., *Cortinarius (Hydrocybe) subferrugineus* (Batsch) Fr., *Pholiota flammans* Fr., *Paxillus giganteus* (Sow.) Fr., *Hydnum imbricatum* (Linn.) Fr., *Helvella monachella* (Scop.) Fr., and *Dianema depressum* Lister.

In the evening, at nine o'clock, the President (Miss Gulielma Lister, F.L.S.) took the chair and the following officers were unanimously elected for the ensuing year:—Mr. A. D. Cotton, F.L.S., President; Mr. D. A. Boyd, Vice-President; and Mr.

Carleton Rea, B.C.L., M.A., &c., Hon. Secretary and Treasurer. The Hon. Secretary reported that he had received an invitation from the Haslemere Natural History Society to visit their neighbourhood next year for the autumn foray, and that their fellow member Mr. E. W. Swanton had offered to make all the necessary arrangements for the meeting. This proposal was unanimously accepted; the date* was to be subsequently fixed by their Hon. Secretary after consulting Mr. E. W. Swanton and the Hon. Secretary of the Haslemere Natural History Society, but it was not to be later if possible than the last week in September. Professor M. C. Potter, Sc.D., M.A., was appointed the delegate to represent the British Mycological Society both at the Birmingham meeting of the British Association in 1913 and also at the " premier Congrès Intérnational de Pathologie Comparée à la Faculté de Medicin de Paris " in October, 1912. Miss A. Lorrain Smith, F.L.S., reported that she had attended the Conference of Delegates of Corresponding Societies at the Dundee meeting of the British Association. As no adequate response had been received to the circular sent to the Societies (see Tr. Bri. Myc. Soc. p. 300, vol. III.) it was resolved that it should be re-issued to the delegates of the Affiliated Societies. Attention was then drawn to the Report of the Agricultural Educational Association (Biology Committee). This Report gives a list of thirty-two very common and well-known fungoid diseases; a strong doubt was expressed as to the correctness of the record of *Fomes annosus* Fr. on Hawthorn.

The Hon. Treasurer reported that their credit balance at the post office savings bank at that date amounted to £34. 4s. 9d.; that the number of members enrolled was one hundred and six; and that six new members had been elected since the last autumn foray, namely, Colonel T. Jermyn, Indian Army, Westfield, South Road, Weston-super-Mare; Mr. Vincent Tothill, London Hospital, London, E.; Mr. Malcolm Wilson, D.Sc., A.R.C.S., F.L.S., Royal Botanic Gardens, Edinburgh; Professor J. H. Priestley, B.Sc., F.L.S., Botanical Department, University of Leeds; Rev T. J. Sewell, M.A., Lynsted Vicarage, Kent; and Mr. F. A. Mason, F.R.M.S., Member of the Society of Public Analysts, The Laboratory, 3, Queen's Square, Leeds. The President then in feeling terms referred to the loss their society had suffered by the death of Dr. W. Watson, Deputy Surgeon General.

On Saturday, the 14th of September, an early start was made from the railway station by the 8-10 a.m. train for Aviemore and the ancient pine forest of Rothiemurchus. On arrival there

* The date selected for the autumn foray is Monday to Saturday, the 22nd to the 29th of September, 1913.

at 9-25, our fellow member Mr. Angus Grant, who is intimately acquainted with this district, led the members to a bridge over the river Spey. A saw yard was visited on the way where some specimens of *Hygrophorus fuscoalbus* (Lasch) Fr. were collected. Rothiemurchus Forest was next explored and yielded some nice examples of *Hydnum scabrosum* Fr., *Hydnum compactum* (Pers.) Fr., *Hydnum ferrugineum* Fr., *Hydnum zonatum* (Batsch) Fr., *Pholiota caperata* (Pers.) Fr., *Hypholoma dispersum* Fr., *Boletus pinicola* (Vitt.) Rea, *Amanita porphyria* (A. & S.) Fr., *Armillaria robusta* (A. & S.) Fr., *Tricholoma ustale* Fr., *Clavaria luteoalba* Rea, *Polystictus Montagnei* Fr., *Trametes pini* (Thore) Fr., *Leptoderma iridescens* G. Lister, *Colloderma oculatum* (Lippert) G. Lister, *Licea minima* Pers. and *L. pusilla* Schrad. The Spey was recrossed and on an adjoining sawdust heap *Boletus sulphureus* Fr. and *Paxillus panuoides* Fr. were found. The portion of Rothiemurchus Forest adjacent to Loch-an-Eilean was next carefully searched. The members returned by the 6-50 p.m. train from Aviemore and arrived at Forres at 8-15 p.m.

On Monday, the 16th of September, the members journeyed to Nairn by the 8-34 a.m. train, from whence they were conveyed in brakes to the entrance gates of Cawdor Castle. The woods on either side of the Hermitage Burn were carefully worked. The following are the most noteworthy finds of the day:—*Lepiota lenticularis* (Lasch) Fr., *Tricholoma columbetta* Fr., *Gomphidius gracilis* Berk., *Cordyceps ophioglossoides* (Ehrh.) Fr., *Inocybe Godeyi* Gillet, *Russula aeruginea* Fr., *Cortinarius (Inoloma) callisteus* Fr., *Cortinarius (Myxacium) pluvius* Fr., *Cortinarius (Inoloma) argentatus* (Pers.) Fr., *Androsaceus Hudsoni* (Berk.) Pat., *Pleurotus porrigens* (Pers.) Fr., *Boletus calopus* Fr., *Boletus purpureus* Fr., *Boletus vaccinus* Fr., *Diderma asteroides* Lister, *Didymium dubium* Rost. and *Lamproderma echinulatum* Rost.

In the evening, after the Club dinner, at nine o'clock, Miss Gulielma Lister, F.L.S., delivered her presidential address entitled "The past Students of Mycetozoa and their Work" (see p. 44). The same evening Mr. R. H. Compton, M.A., Caius College, Cambridge, was unanimously elected a member of the Society.

On Tuesday, the 17th of September, the morning was devoted to the critical examination of the specimens collected on the previous day, and at eleven o'clock a start was made from the headquarters for Cluny Hill, which dominates the town of Forres. Here a photograph of the members, which is reproduced in this number of the Transactions, was taken by a professional photographer. The members then dispersed in all directions in their quest for fungi. The following species were obtained:—

D. Mackenzie. W. R. Baxter. R. B. Johnstone. Mrs. E. A. Rea.
Miss B Shadwell. Angus Grant. Miss A. Hibbert-Ware. J. Ramsbottom. A. A. Pearson. Violet Rea. R. Finlayson. Motherwell.

Rev. R. Barr. W. N. Cheesman. Miss C. A. Cooper. Dr. J. W. Ellis. A. D. Cotton. Miss B. K. Taylor. Mrs. R. Smith. Rupert Smith. Rennison.
D. A. Boyd. Rev. D. Paul. Carleton Rea. Miss Gulielma Lister (President). Professor M. C. Potter. Mrs. Potter. Miss A. Lorraine Smith.

Collybia distorta Fr., *Tricholoma portentosum* Fr., *Paxillus atrotomentosus* (Batsch) Fr., *Paxillus lepista* Fr., *Marasmius foetidus* (Sow.) Fr., *Pholiota flammans* Fr., *Russula incarnata* Quél., *Amanita porphyria* (A. & S.) Fr. and *Cortinarius (Telamonia) gentilis* Fr. At two o'clock the walk was continued to the grounds of Sanquhar House, distant about half-a-mile away, but the woods and pastures yielded only a few noteworthy specimens, namely, *Tricholoma carneum* (Bull.) Fr., *Psaliota purpurascens* Cke. and *Gomphidius maculatus* (Scop.) Fr. Another section of the members, under the leadership of the President, drove down to the Culbin Sandhills, and were rewarded with the subjoined finds:—*Inocybe abjecta* Karst. (new to Britain), *Tricholoma bufonium* (Pers.) Fr., *Cortinarius (Telamonia) limonius* Fr., *Marasmius cauticinalis* (With.) Fr., *Microglossum arenarium* Rostrup (new to Britain), *Xylaria Tulasnei* Nke., *Amaurochaete fuliginosa* (Sow.) Macbr. and *Dianema corticatum* Lister.

In the evening, at nine o'clock, Mr. J. Ramsbottom, B.A., read a paper on "The History of the classification of the Uredinaceae" (see page 77).

On Wednesday, the 19th of September, after the specimens collected on the previous day had been examined, the members entered the brakes at eleven o'clock and drove to Sluie on the Findhorn river. The right bank of this picturesque stream was explored up to the bridge that crosses the river Divie. An abundant growth of fungi was present everywhere, amongst which we may enumerate *Tricholoma sejunctum* (Sow.) Fr.,*Pleurotus acerosus* Fr., *Tricholoma ustale* Fr., *Boletus pinicola* (Vitt.) Rea., *Boletus pachypus* Fr., *Sparassis crispa* (Wulf.) Fr., *Cortinarius (Telamonia) macropus* (Pers.) Fr., *Cortinarius (Telamonia) bivelus* Fr., *Cortinarius (Hydrocybe) damascenus* Fr., *Cortinarius (Dermocybe) raphanoides* (Pers.) Fr., *Flammula rubicundula* Rea, and *Russula caerulea* (Pers.) Fr. The carriages were re-entered at Divie Bridge and the drive continued past Daltulich Bridge to the southern portion of Darnaway Forest. It was now getting somewhat late and only a hurried examination of the Forest was possible, but the bag was found to include *Mycena atromarginata* Fr., *Cortinarius (Hydrocybe) dolabratus* Fr., *Cortinarius (Telamonia) ileopodius* (Bull.) Fr., *Geoglossum ophioglossoides* (Linn.) Sacc. (= *G. glabrum* Pers.), *Clavaria luteoalba* Rea and *Badhamia rubiginosa* (Chev.) Rost. var. *dictyospora* Lister.

In the evening, on the conclusion of the Council and business meetings of the Cryptogamic Society of Scotland, Mr. D. A. Boyd read a paper "Notes on the Fungus Flora of the Moray District" (see page 66).

Hearty votes of thanks were passed to the Earls of Cawdor

and Moray, Sir William Gordon Cumming, Sir Alfred Monde, M.P., Mr. Edwards of Sanquhar, and Mr. J. P. Grant of Rothiemurchus, for the kind permission they had given the members to visit their woods and policies, and to their factors, Messieurs William Fenwick, William Munro, James Pearson, J. S. Robertson, and J. S. Leask, for the arrangements they had made for conducting the members through the estates; special thanks were voted to Mr. J. S. Leask for the great trouble that he had taken in arranging the details of the programme for the Forres foray, and to the trustees of the Falconer Museum for so kindly placing that institution and their mycological works at the disposal of our members. Mr. George H. Ogilvie, B.Sc., Indian Forest Service, Burmah, of Westlands, Broughty Ferry, N.B., was unanimously elected a member.

On Thursday, the 20th of September, the early part of the morning was devoted to the elucidation of critical species. At eleven o'clock the members started in brakes for Blair's Loch, some three miles away. Here the carriages were dismissed and the members spread out in various directions to explore the recesses of the Altyre Woods. Late in the afternoon they reassembled at the headquarters. The records for the day included *Boletus scaber* (Bull.) Fr. *var. aurantiacus* (Bull.) Fr., *Mycena atromarginata* Fr., *Tricholoma virgatum* Fr., *Boletus pinicola* (Vitt.) Rea, *Cortinarius (Hydrocybe) subferrugineus* (Batsch) Fr., *Hypholoma dispersum* Fr., *Mitrula cucullata* (Batsch) Fr., *Cortinarius (Inoloma) tophaceus* Fr., *Sistotrema confluens* (Pers.) Fr., *Amanita porphyria* (A. & S.) Fr., *Pleurotus corticatus* Fr., *Hydnum nigrum* Fr., *Hydnum aurantiacum* (Batsch) Fr., *Hydnum ferrugineum* Fr., *Helvella lacunosa* (Afz.) Fr., *Melachroia (=Humaria) xanthomela* (Pers.) Boud., *Boletus reticulatus* (Schaeff.) Boud., and *Boletus rugosus* Fr.

Seven hundred and twenty-six species of fungi were collected during the foray. The Hon. Secretary has to thank our Vice-President (Mr. D. A. Boyd), Dr. J. W. Ellis, Mr. A. D. Cotton, Miss E. M. Wakefield and Sir Henry Hawley, for their kind assistance in preparing the subjoined list.

COMPLETE LIST OF FUNGI GATHERED DURING THE FORAY.

Species noted only at one or two places are marked *A.* = Altyre Woods; *C.* = Cawdor Castle Woods; *Cl.* = Cluny Hill, Forres; *D.* = Darnaway Forest; *F.* = Findhorn River between Sluie and Divie Bridge; *G.* = Glenferness House; *R.* = Rothiemurchus Forest; and *S.* = Sanquhar Woods.

Amanita phalloides (Vaill.) Fr. *C.*, verna (Bull.) Fr. *C.*, mappa (Batsch) Fr. *A.*, *C.*, *R.*, *S.*, porphyria (A. & S.) Fr. *A.*, *Cl.*, *R.*, aureola Kalchbr. *A.*, muscaria (Linn.) Fr., var. formosa Gonn. & Rab., rubescens Fr., nitida Fr. *R.*

Amanitopsis vaginata (Bull.) Roze *A.*, *F.*, *G.*, *S.*, fulva (Schaeff.) W. G. Sm. *C.*, strangulata (Fr.) Roze *D.*

Lepiota procera (Scop.) Fr. *R.*, rachodes (Vitt.) Fr. *Cl.*, *A.*, excoriata (Schaeff.) Fr., cristata (A. & S.) Fr. *A.*, carcharias (Pers.) Fr., amianthina (Scop.) Fr., lenticularis (Lasch) Fr., *C.*

Armillaria robusta (A. & S.) Fr. *A.*, *C.*, *R.*, mellea (Vahl.) Fr.

Tricholoma equestre (Linn.) Fr. *A.*, *R.*, sejunctum (Sow.) Fr. *F.*, portentosum Fr., resplendens Fr., albobrunneum (Pers.) Fr., ustale Fr. *F.*, *R.*, rutilans (Schaeff.) Fr., columbetta Fr. *C.*, *Cl.*, imbricatum Fr. *A.*, *Cl.*, *F.*, vaccinum Fr. *Cl.*, *G.*, *A.*, terreum (Schaeff.) Fr., argyraceum (Bull.) Fr. *Cl.*, saponaceum Fr., var. squamosum Cke., murinaceum (Bull.) Fr. *R.*, virgatum Fr. *A.*, *R.*, sulphureum (Bull.) Fr., bufonium (Pers.) Fr. *A.*, *Culbin Sandhills*, lascivum Fr. *G.*, carneum (Bull.) Fr. *S.*, album (Schaeff.) Fr., glaucocanum Bres., *C.*, *Cl.*, *G.*, nudum (Bull.) Fr., melaleucum (Pers.) Fr. *Cl.*, *R.*, *S.*, var. phaeopodium (Bull.) Quél. *Culbin Sandhills.*

Clitocybe nebularis (Batsch) Fr., clavipes (Pers.) Fr., odora (Bull.) Fr. *G.*, viridis (With.) Fr., cerussata Fr. *D.*, *R.*, dealbata (Sow.) Fr. *C.*, infundibuliformis (Gaertn.) Fr., geotropa (Bull.) Fr. *A.*, inversa (Scop.) Fr. *C.*, *A.*, flaccida (Sow.) Fr. *A.*, cyathiformis (Bull.) Fr., metachroa Fr., ditopoda Fr., fragrans (Sow.) Fr. *C.*

Laccaria laccata (Scop.) B. & Br., var. amethystina (Vaill.) B. & Br., tortilis (Bolt.) B. & Br.

Collybia radicata (Relh.) Fr., *Cl.*, *F.*, platyphylla Fr., fusipes

(Bull.) Fr. *C.*, maculata (A. & S.) Fr., distorta Fr. *A.*, *Cl.*, butyracea (Bull.) Fr., velutipes (Curt.) Fr. *R.*, stipitaria Fr. *Cl.*, confluens (Pers.) Fr. *A.*, *C.*, *G.*, tuberosa (Bull.) Fr., tenacella (Pers.) Fr. *A.*, *Cl.*, rancida Fr. *A.*, *C.*, atrata Fr. *C.*, *Cl.*, *D.*, *R.*

Mycena Iris Berk. *C.*, elegans (Pers.) Fr. *Cl.*, *R.*, atromarginata Fr. *A.*, *D.*, rubromarginata Fr. *Cl.*, strobilina (Pers.) Fr. *A.*, *C.*, *Cl.*, *R.*, rosella Fr. *F.*, pura (Pers.) Fr., flavoalba Fr. *Cl.*, lactea (Pers.) Fr. *G.*, rugosa Fr., galericulata (Scop.) Fr., polygramma (A.&S.) Fr. *A.*, atroalba (Bolt.) Fr. *F.*, alcalina Fr., ammoniaca Fr. *C.*,*A.*, amicta Fr. *Cl.*, *R.*, debilis Fr. *A.*, haematopoda (Pers.) Fr. *A.*, *C.*, *G.*, *S.*, galopoda (Pers.) Fr. *D.*, sanguinolenta (A. & S.) Fr. *C.*, epipterygia (Scop.) Fr. *C.*, *F.*, pelliculosa Fr. *Culbin Sandhills*, vulgaris (Pers.) Fr., tenerrima Berk. *F.*, discopoda Lév. *Culbin Sandhills.*

Omphalia rustica Fr. *C.*, *R.*, umbellifera (Linn.) Fr. *A.*, *C.*, *G.*, *R.*, fibula (Bull.) Fr. *C*, var Swartzii Karst. *R.*, integrella (Pers.) Fr. *S.*

Pleurotus corticatus Fr. *A.*, acerosus Fr. *F.*, porrigens (Pers.) Fr. *A.*, *C.*, *F.*, applicatus (Batsch) Fr. *R.*

Hygrophorus eburneus (Bull.) Fr., cossus (Sow.) Fr. *C.*, hypothejus Fr., fuscoalbus (Lasch) Fr. *R.*, agathosmus Fr., pratensis (Pers.) Fr., virgineus (Wulf.) Fr., niveus (Scop.) Fr., laetus (Pers.) Fr. *C.*, *K.*, *R.*, vitellinus Fr. *Cl.*, coccineus (Schaeff.) Fr., miniatus Fr. *R.*, turundus Fr. *A.*, puniceus Fr. *A.*, *R.*, conicus (Scop.) Fr., chlorophanus Fr. *A.*, psittacinus (Schaeff.) Fr., unguinosus Fr. *C.*

Lactarius torminosus (Schaeff.) Fr. *A.*, *C.*, turpis (Weinm.) Fr., pubescens Fr., blennius Fr., uvidus Fr., pyrogalus (Bull.) Fr., chrysorheus Fr. *A.*, *C.*, piperatus (Scop.) Fr. *G.*, vellereus Fr., deliciosus (Linn.) Fr., pallidus Fr. *C. F.*, quietus Fr., aurantiacus (Fl. Dan.) Fr., vietus Fr., rufus (Scop.) Fr., glyciosmus Fr., serifluus (DC.) Fr. *A.*, mitissimus Fr. *A.*, *C.*, *Cl.*, *G.*, subdulcis (Bull.) Fr.

Russula nigricans (Bull.) Fr. *C.*, *G.*, adusta (Pers.) Fr. *Cl.*, *G.*, chloroides (Krombh.) Bres. *C.*, mustelina Fr., olivascens Fr. *F.*, rosacea Fr. *A.*, sardonia Bres., caerulea (Pers.) Fr., *Cl.*, *F.*, *K.*, drimeia Cke. (=expallens Gillet), incarnata Quél. *Cl.*, virescens (Schaeff.) Fr. *Cl.*, cutifracta Cke., lepida Fr. *A.*, rubra (DC.) Fr. *A.*, *C.*, olivacea (Schaeff.) Fr. *F.*, *Cl.*, vesca Fr. *R.*, cyanoxantha (Schaeff.) Fr., heterophylla Fr. *A.*, *C.*, *Cl.*, *R.*, galochroa Fr. *R.*, foetens (Pers.) Fr., fellea Fr., Queletii Fr. *A.*, *Cl.*, emetica Fr., fallax (Schaeff.) Fr. *Cl.*, ochroleuca (Pers.) Fr., citrina Gillet *C.*, *Cl.*,

aeruginea Fr. *C.*, *Cl.*, fragilis (Pers.) Fr. var. nivea Cke., var. violacea Cke., nitida (Pers.) Fr. *R.*, var. cuprea (Krombh.) Fr. *A.*, alutacea (Pers.) Fr., ochracea (Pers.) Fr.

Cantharellus cibarius Fr., aurantiacus (Wulf) Fr. *R.*, umbonatus (Gmel.) Fr. *G.*, tubaeformis (Bull.) Fr. *C.*, *G.*, infundibuliformis (Scop.) Fr. *F.*

Nyctalis parasitica (Bull.) Fr. *Cl.*, *F.*

Marasmius peronatus (Bolt.) Fr. *F.*, oreades (Bolt.) Fr., foetidus (Sow.) Fr. *Cl.*, ramealis (Bull.) Fr., cauticinalis (With.) Fr. *Culbin Sandhills.*

Androsaceus rotula (Fr.) Pat., *A.*, *C.*, androsaceus (Linn.) Pat., Hudsoni (Berk.) Pat. *C.*, epiphylloides Rea *C.*, *D.*

Lentinus cochleatus (Pers.) Fr. *near Forres.*

Panus conchatus (Bull.) Fr. *F.*, stypticus (Bull.) Fr.

Lenzites betulina (Linn.) Fr., flaccida (Bull.) Fr., saepiaria (Wulf) Fr.

Pluteus cervinus (Schaeff.) Fr. *R.*, *S.*

Entoloma lividum (Bull.) Fr. *Cl.*, *D.*, porphyrophaeum Fr. *R.*, ameides B. & Br. *R.*, jubatum Fr. *A.*, costatum Fr. *C.*, sericeum (Bull.) Fr., nidorosum Fr. *A.*, *C.*, *G.*

Clitopilus prunulus (Scop.) Fr. *C.*, popinalis Fr. *Findhorn Village.*

Leptonia lampropoda Fr. *R.*, formosa Fr. *F.*, sericella (Fr.) Quél. *C.*

Nolanea pascua (Pers.) Fr., pisciodora (Ces.) Fr. *C.*, *R.*

Claudopus variabilis (Pers.) W. G. Sm. *R.*

Pholiota caperata (Pers.) Fr. *R.*, praecox (Pers.) Fr. *Cl.*, squarrosa (Müll.) Fr. *C.*, *G.*, *R.*, spectabilis Fr., flammans Fr. *A.*, *Cl.*, *G.*, mutabilis (Schaeff.) Fr., marginata (Batsch) Fr. *A.*, *C.*

Inocybe hystrix Fr., cincinnata Fr. *C.*, *R.*, pyriodora (Pers.) Fr., flocculosa Berk. *A.*, *Cl.*, maritima Fr. *Culbin Sandhills*, rimosa (Bull.) Fr., eutheles B. & Br. *C.*, abjecta Karst. *Culbin Sandhills*, Godeyi Gillet *A.*, *C.*, *Cl.*, fastigiata (Schaeff.) Fr. *C.*, geophylla (Sow.) Fr., var. violacea Pat.

Hebeloma fastibile Fr., glutinosum (Lindg.) Fr. *A.*, *Cl.*, *S.*, mesophaeum Fr. *C.*, *Cl.*, *R.*, crustuliniforme (Bull.) Fr. *C.*, *F.*, elatum (Batsch) Fr. *C.*

Flammula carbonaria Fr. *D.*, *R.*, rubicundula Rea *R.*, *F.*, inopoda Fr. *C.*, *Cl.*, sapinea Fr.

Naucoria melinoides (Bull.) Fr. *Cl.*, *F.*, *G.*, escharoides Fr. *R.*

Galera tenera (Schaeff.) Fr., hypnorum (Schrank) Fr. var. sphagnorum (Pers.) Fr. *R.*

Tubaria furfuracea (Pers.) W. G. Sm.

Crepidotus alveolus (Lasch) Fr. *G.*, *R.*, mollis (Schaeff.) Fr.

Cortinarius (Phlegmacium) triumphans Fr. *Cl.*, *F.*, *G.*, claricolor

Fr. *Forres*, varius (Schaeff.) Fr. *F.*, largus (Buxb.) Fr. *C.*, glaucopus (Schaeff.) Fr. *G.*, purpurascens (Batsch) Fr. *Cl.*, prasinus (Schaeff.) Fr. *Cl.*

(Myxacium) mucosus (Bull.) Fr., collinitus (Pers.) Fr. *Cl.*, elatior Fr. *A.*, *F.*, *R.*, *S.*, vibratilis Fr. *Cl.*, pluvius Fr. *C.*

(Inoloma) argentatus (Pers.) Fr. *C.*, alboviolaceus (Pers.) Fr., tophaceus Fr. *A.*, callisteus Fr. *A.*, *C.*, pholideus Fr.

(Dermocybe) ochroleucus (Schaeff.) Fr. *A.*, *C.*, *R.*, tabularis (Bull.) Fr., camurus Fr. *G.*, caninus Fr., azureus Fr. *A.*, anomalus Fr., lepidopus Cke. *A.*, *F.*, miltinus Fr., sanguineus (Wulf) Fr. *F.*, cinnamomeus (Linn.) Fr., semisanguineus Fr., raphanoides (Pers.) Fr. *A.*, *F.*

(Telamonia) macropus (Pers.) Fr. *F.*, bivelus Fr. *F.*, bulbosus (Sow.) Fr. *A.*, *F.*, torvus Fr., armillatus Fr., limonius Fr. *R.*, *Culbin Sandhills*, helvolus (Bull.) Fr. *Cl.*, *G.*, hinnuleus (Sow.) Fr., gentilis Fr. *A.*, *Cl.*, *R.*, brunneus (Pers.) Fr. *A.*, *Cl.*, *F.*, *R.*, *S.*, brunneofulvus Fr. *C.*, iliopodius (Bull.) Fr. *D.*, *F.*, *R.*, hemitrichus (Pers.) Fr., *A.*, *Cl.*, *F.*, rigidus (Scop.) Fr. *A.*, *C.*, *Cl.*, *F.*, paleaceus (Weinm.) Fr. *A.*, *C.*, *Cl.*, *R.*

(Hydrocybe) subferrugineus (Batsch) Fr. *A.*, *G.*, *F.*, *R.*, armeniacus (Schaeff.) Fr. *A.*, *Cl.*, damascenus Fr. *F.*, saturninus Fr. *Cl.*, castaneus (Bull.) Fr. *Cl.*, *R.*, uraceus Fr. *R.*, dolabratus Fr. *D.*, *F.*, leucopus (Pers.) Fr. *A.*, *Cl.*, *F.*, *R.*, *S.*, erythrinus Fr. *F.*, decipiens (Pers.) Fr., germanus Fr. *A.*, obtusus Fr. *C.*, *F.*, *R.*, *Culbin Sandhills*, acutus (Pers.) Fr. *D.*, *F.*

Paxillus giganteus (Sow.) Fr. *G.*, *R.*, lepista Fr. *Cl.*, involutus (Batsch) Fr., atrotomentosus (Batsch) Fr., panuoides Fr. *R.*

Psaliota arvensis (Schaeff.) Fr. *Culbin Sandhills*, purpurascens Cke. *S.*, xanthoderma Genev. *C.*, campestris (Linn.) Fr., silvicola (Vitt.) Fr. *G.*, haemorrhoidaria Kalchbr. *A.*, *Cl.*, *R.*, comtula Fr.

Stropharia aeruginosa (Curt.) Fr., albocyanea (Desm.) Fr. *C.*, *Cl.*, coronilla (Bull.) Fr., squamosa Fr. *Cl.*, *D.*, Worthingtonii Fr. *A.*, *R.*, semiglobata (Batsch) Fr. *D.*, *R.*

Hypholoma sublateritium (Schaeff.) Fr., capnoides Fr., epixanthum (Paul.) Fr., fasciculare (Huds.) Fr., dispersum Fr. *A.*, *C.*, *Cl.*, *F.*, *R.*, lacrymabundum Fr. *C.*, velutinum (Pers.) Fr. *C.*, *S.*, appendiculatum (Bull.) Fr. *A.*, hydrophilum (Bull.) Fr. *R.*

Psilocybe sarcocephala Fr. *C.*, semilanceata Fr. *D.*, foenisecii (Pers.) Fr. *R.*
Psathyra corrugis (Pers.) Fr., gyroflexa Fr. *A.*, bifrons Berk. *A.*, semivestita B. & Br. *A.*, fibrillosa (Pers.) Fr. *A.*, *C.*, *Cl.*, *R.*, *S.*
Bolbitius titubans (Bull.) Fr. *F.*
Coprinus comatus (Fl. Dan.) Fr., atramentarius (Bull.) Fr., cinereus Fr. *Cl.*, *R.*, niveus (Pers.) Fr., micaceus (Bull.) Fr., ephemerus (Bull.) Fr., plicatilis (Curt.) Fr. *S.*
Panaeolus sphinctrinus Fr. *Cl.*, campanulatus (Linn.) Fr., papilionaceus (Bull.) Fr. *A.*
Anellaria separata (Linn.) Karst. *Findhorn Village.*
Psathyrella gracilis (Pers.) Fr., atomata Fr., disseminata (Pers.) Fr. *A.*, *C.*
Gomphidius glutinosus (Schaeff.) Fr. *A.*, *C.*, *G.*, roseus (Fr.) Quél. *A.*, viscidus (Linn.) Fr., maculatus (Scop.) Fr. *S.*, gracilis Berk. *C.*, *Cl.*
Boletus luteus Fr., elegans (Schum.) Fr., bovinus (Linn.) Fr., badius (Linn.) Fr., piperatus (Bull.) Fr. *Cl.*, variegatus (Swartz) Fr., sulphureus Fr. *R.*, chrysenteron (Bull.) Fr. *A.*, *C.*, *S.*, subtomentosus (Linn.) Fr., calopus Fr., *C.*, *Cl.*, pachypus Fr. *F.*, edulis (Bull.) Fr., reticulatus (Schaeff.) Boud. *A.*, pinicola (Vitt.) Rea *A.*, *Cl.*, *C.*, *F.*, *R.*, vaccinus Fr. *A.*, *C.*, *Cl.*, *R.*, *S.*, luridus (Schaeff.) Fr. *C.*, *Cl.*, *F.*, purpureus Fr. *C.*, versipellis Fr., scaber (Bull.) Fr., var. aurantiacus (Bull.) Fr. *A.*, rugosus Fr. *A.*
Fistulina hepatica (Huds.) Fr.
Polyporus Schweinitzii Fr. *A.*, *C.*, *F.*, *R.*, squamosus (Huds.) Fr., calceolus (Bull.) Quél., *Cl.*, *S.*, nummularius Fr. *A.*, varius (Pers.) Fr. *A.*, sulphureus (Bull.) Fr., fragilis Fr. *Cl.*, caesius (Schrad.) Fr. *C.*, adustus (Willd.) Fr., amorphus Fr. *A.*, *C.*, *Cl.*, *G.*, hispidus (Bull.) Fr. *C.*, betulinus (Bull.) Fr.
Fomes nigricans Fr., annosus Fr.
Polystictus Montagnei Fr. *A.*, *R.*, perennis (Linn.) Fr. *C.*, *R.*, radiatus (Sow.) Fr., versicolor (Linn.) Fr., velutinus (Pers.) Fr. *A.*, *Cl.*, abietinus (Dicks.) Fr. *A.*, *Cl.*, *D.*, *S.*
Poria vulgaris Fr. *G.*, *S.*, mollusca (Pers.) Fr. *A.*, *C.*, mucida Fr. *A.*, vaporaria Pers. *A.*, *Cl.*, sanguinolenta Fr. *A.*, *C.*, blepharistoma B. & Br. *A.*, terrestris (DC.) Fr. *A.*, *F.*
Trametes pini (Thore) Fr. *G.*, *R.*, mollis (Somm.) Fr. *G.*
Daedalea quercina (Linn.) Fr.
Merulius tremellosus (Schrad.) Fr. *R.*, corium (Pers.) Fr. *F.*, molluscus Fr. *A.*, *R.*, *Culbin Sandhills.*
Porothelium confusum B. & Br. *G.*
Solenia anomala (Pers.) Fr. *G.*, *R.*, *Culbin Sandhills.*

Ptychogaster albus Cda. *C.*

Hydnum imbricatum (Linn.) Fr. *A.*, *C.*, *G.*, *R.*, scabrosum Fr. *R.*, repandum (Linn.) Fr., rufescens (Pers.) Fr. *C.*, compactum (Pers.) Fr. *A.*, *R.*, aurantiacum (Batsch) Fr. *A.*, *Cl.*, ferrugineum Fr. *A.*, *F.*, *R.*, zonatum (Batsch) Fr. *A.*, *R.*, nigrum Fr. *A.*, *F.*, melaleucum Fr. *Cl.*, auriscalpium (Linn.) Fr. *A.*, ochraceum (Gmel.) Fr. *C.*, alutaceum Fr. *A.*, niveum (Pers.) Fr. *A.*, *C.*, *Cl.*, *G.*, farinaceum (Pers.) Fr. *A.*, *G.*

Sistotrema confluens (Pers.) Fr. *A.*

Irpex obliquus (Schr.) Fr.

Radulum quercinum (Pers.) Fr. *C.*

Phlebia radiata Fr. *S.*, vaga Fr.

Grandinia granulosa (Pers.) Fr., mucida Fr. *C.*, *R.*

Odontia fimbriata (Pers.) Fr.

Craterellus cornucopioides (Linn.) Fr. *C.*, *G.*

Sparassis crispa (Wulf) Fr. *F.*

Thelephora laciniata (Pers.) Fr. *A.*, *Cl.*, *G.*, *R.*

Stereum hirsutum (Willd.) Fr., purpureum (Pers.) Fr., sanguinolentum (A. & S.) Fr. *A.*, *G.*

Hymenochaete rubiginosa (Dicks.) Lév. *S.*

Corticium lacteum Fr. *A.*, sanguineum Fr. *A.*, *R.*, calceum (Pers.) Fr., trigonospermum* Bres.

Peniophora quercina (Pers.) Cke. *Cl.*, gigantea (Fr.) Massee *R.*, cinerea (Pers.) Cke. *A.*, *C.*, *G.*, velutina (DC.) Cke., incarnata (Pers.) Massee *A.*

Coniophora puteana (Schum.) Fr. *G.*

Exobasidium vaccinii Woron. *G.*, *R.*

Clavaria muscoides (Linn.) Fr. *Cl.*, cinerea (Bull.) Fr. *A.*, *C.*, *Cl.*, cristata (Pers.) Fr. *A.*, *Cl.*, *G.*, *R.*, rugosa (Bull.) Fr. *A.*, *C.*, *Cl.*, *G.*, abietina (Pers.) Fr. *Cl.*, fusiformis (Sow.) Fr. *R.*, luteoalba Rea *A.*, *D.*, *R.*, dissipabilis Britz. *A.*, *Cl.*, *D.*, *F.*, argillacea (Pers.) Fr. *Culbin Sandhills.*

Pistillaria quisquiliaris Fr. *F.*

Auricularia mesenterica (Dicks.) Fr. *R.*

Exidia recisa (Ditm.) Fr. *A.*, glandulosa (Bull.) Fr., albida (Huds.) Bref. *A.*, *Cl.*

Phaeotremella pseudofoliacea Rea.

Tremella mesenterica (Retz.) Fr. *A.*, *D.*, indecorata (Somm.) Fr. *C.*, sarcoides W. G. Sm. *A.*, *G.*, *R.*

Dacryomyces deliquescens (Bull.) Duby., stillatus (Nees) Fr. *A.*, *C.*, *R.*

Calocera viscosa (Pers.) Fr., stricta Fr. *C.*, *D.*, *G.*

Ithyphallus impudicus (Linn.) Fisch *A.*, *C.*, *F.*

Mutinus caninus (Huds.) Fr. *A.*

*For description of this species see p. 116.

Nidularia pisiformis (Roth) Tul., *on Rabbit dung, Culbin Sandhills*
Sphaerobolus stellatus (Tode) Pers. *G.*, *R.*
Cyathus vernicosus (Bull.) DC. *C.*
Crucibulum vulgare Tul. *C.*, *Cl.*, *R.*
Bovista plumbea Pers., nigrescens Pers. *R.*, *S.*
Lycoperdon perlatum Pers., caelatum (Bull.) Fr. *R.*, pyriforme (Schaeff.) Pers., umbrinum Pers. *A.*, *Cl.*, *D.*, *F.*, saccatum (Vahl.) Fr. *A.*, *R.*, spadiceum Pers. (= Cookei Mass.) *A.*, *Sandhills near Findhorn Village.*
Uromyces fabae (Pers.) Schröter *Cl.*, *F.*, *S.*, polygoni (Pers.) Fuck. *Cl.*, *F.*, *S.*, trifolii (A. & S.) Wint. *Cl.*, *F.*, *S.*, geranii (DC.) Otth. & Wartm. *G.*, rumicis (Schum.) Wint. *Cl.*, *F.*, *S.*, alchaemillae (Pers.) Wint. *Cl.*, *F.*, *S.*
Puccinia galii (Pers.) Wint. *Cl.*, *F.*, *S.*, calthae Link *Cl.*, *F.*, *S.*, lapsanae (Schultz) Fckl. *Cl.*, *F.*, *S.*, violae (Schum.) DC., *Cl.*, *F.*, *G.*, *S.*, pimpinellae (Strauss) Mart. *Cl.*, *F.*, *S.*, graminis Pers. *Cl.*, *F.*, *S.*, rubigo-vera (DC.) Wint. *Cl.*, *F.*, *R.*, *S.*, obtegens (Link) Tul. (= suaveolens Rostrup) *Cl.*, *F.*, *S.*, hieracii (Schum.) Mart. *Cl.*, *F.*, *S.*, centaureae Mart. *Cl.*, *F.*, *S.*, oblongata (Link) Wint. *on Luzula sylvatica*, *C.*, *Cl.*, *F.*, *G.*, *S.*, glomerata Grev. *Cl.*, *F.*, *R.*, *S.*, arenariae (Schum.) Wint. *Cl.*, *F.*, *S.*, annularis (Strauss) Schlecht. *G.*
Phragmidium violaceum (Schultz) Wint. *C.*, *Cl.*, *Culbin Sandhills*, *F.*, *S.*, subcorticatum (Schrank) Wint. *Cl.*, *F.*, *S.*, rubi (Pers.) Wint. *F.*, rubi-Idaei (Pers.) Wint. *Cl.*, *F.*, *S.*,
Gymnosporangium juniperinum (Linn.) Fr. *C.*, *Cl.*, *F.*, *R.*, *S.*, *on leaves of Pyrus Aucuparia.*
Melampsora farinosa (Pers.) Schröt. *Cl.*, *F.*, *G.*, *S.*, vitellinae (DC.) Thüm. *G.*, tremulae Tul. *G.*, populina (Jacq.) Lév. *Cl.*, *F.*, *S.*, hypericorum (DC.) Schröt. *G.*, vacciniorum (Link) Wint. *G.*, orchidi-repentis (Plow.) Kleb. *F.*, *on leaves of Goodyera repens.*
Melampsoridium betulinum (Pers.) Kleb., *C.*, *Cl.*, *F.*, *G.*, *R.*, *S.*
Cronartium ribicolum Dietr. *Cl.*, *F.*, *S.*
Coleosporium senecionis (Pers.) Fr. *Cl.*, *Culbin Sandhills*, *F.*, *S.*, tussilaginis (Pers.) Klebahn *Cl.*, *F.*, *S.*, campanulae (Pers.) Lév. *G.*, euphrasiae (Schum.) Wint. *Cl.*, *F.*, *S.*
Milesia polypodii B. White *G.*
Ustilago hypodytes (Schlecht.) Fr. *sands near Findhorn Village, on Ammophila arenaria.*
Tilletia decipiens (Pers.) Körn *R.*
Sphaerotheca castagnei Lév. *R.*
Podosphaera tridactyla (Wallr.) de Bary *R.*, *on Prunus Padus*, myrtillina (Schub.) Kze. *G.*, *R.*, *on Vaccinium*, oxyacanthae (DC.) de Bary *Cl.*, *F.*, *S.*

Erysiphe Martii Lév. *Cl.*, *F.*, *S.*, umbelliferarum de Bary *Cl.*, *F.*, *S.*
Uncinula aceris (DC.) Sacc. *Cl.*, *F.*, *G.*, *S.*
Microsphaera berberidis (DC.) Lév. *Cl.*, *F.*, *S.*, grossulariae (Wallr.) Lév. *Cl.*, *F.*, *S.*
Capnodium salicinum (A. & S.) Mont. *Cl.*
Nectria cinnabarina (Tode) Fr., coccinea (Pers.) Fr. *A.*, episphaeria (Tode) Fr. *A.*, *C.*, *G.*
Hypomyces rosellus (A. & S.) Tul. *A.*, *G.*, aurantius (Pers.) Tul. *A.*, *Cl.*
Hypocrea rufa (Pers.) Fr. *A.*, *R.*, gelatinosa (Tode) Fr. *R.*
Claviceps purpurea (Fr.) Tul. *R.*
Cordyceps militaris (Linn.) Fr. *A.*, *Cl.*, ophioglossoides (Ehrh.) Link *A.*, *C.*, *D.*
Leptospora ovina (Pers.) Fckl. *A.*
Melanomma pulvispyrius (Pers.) Fckl. *A.*, *C.*, *Cl.*, *G.*, pulvisculum (Curr.) Sacc. *R.*
Cucurbitaria berberidis (Pers.) Gray *Cl.*, *F.*, *S.*, laburni (Pers.) de Not. *Cl.*, *F.*, *S.*, spartei de Not. *Cl.*, *F.*, *G.*, *S.*
Stigmatea robertiani Fr. *Cl.*, *F.*, *G.*, *S.*
Laestadia faginea (Aud.) Cke. & Phil. *Cl.*, *F.*, *S.*
Sphaerella rumicis (Desm.) Cke. *Cl.*, *F.*, *S.*, vaccinii Cke. *R.*
Pleospora herbarum (Pers.) Rabh. *A.*, *F.*
Diaporthe Wibbei Nke. *R. on Myrica gale.*
Melanconis stilbostoma (Fr.) Tul. *Cl.*, *F.*, *G.*, *R.*, *S.*, alni Tul. *Cl.*, *F.*, *S.*
Diatrypella quercina (Pers.) Nke. *A.*, *Cl.*, *S.*
Diatrype stigma (Hoffm.) de Not. *A.*, *Cl.*, *G.*, disciformis (Hoffm.) Fr. *G.*, *R.*
Hypoxylon multiforme Fr. *F.*, rubiginosum (Pers.) Fr. *G.*, fuscum (Pers.) Fr., coccineum Bull. *A.*, *Cl.*
Ustulina vulgaris Tul. *A.*, *C.*, *G.*
Xylaria hypoxylon (Linn.) Grev., Tulasnei Nke. *Culbin Sandhills on rabbit dung.*
Phyllachora heraclei (Fr.) Fckl. *Cl.*, *F.*, *S.*, junci (Fr.) Fckl. *Cl.*, *F.*, *S.*, graminis (Pers.) Fckl. *Cl.*, *F.*, *S.*, angelicae (Fr.) Fckl. *Cl.*, *F.*, *S.*, podagrariae (Roth.) Karst. *Cl.*, *F.*, *S.*
Dothidella betulina (Fr.) Sacc. *A.*, *Cl.*, *R.*
Dothidea sambuci (Pers.) Fr. *R.*
Helvella lacunosa (Afz.) Phill. *A.*, monachella (Scop.) Fr. *G.*
Leptopodia (=Helvella) elastica (Bull.) Boud. *C.*
Acetabula vulgaris (Linn.) Fckl. *A.*
Macropodia (=Helvella) macropus (Pers.) Fckl. *A.*, *C.*, *Cl.*, *R.*
Rhizina inflata (Schaeff.) Karst. *F.*
Galactinia (=Peziza) badia (Pers.) Boud. *C.*, *Cl.*, *F.*, *S.*, succosa (Berk.) Cke. *A.*

Otidea onotica (Pers.) Fckl. *A.*, *C.*, *Cl.*, *F.*, *R.*, cochleata (Linn.) Fckl. *A.*
Peziza (=Otidea) aurantia (Pers.) Fr. *A.*, *C.*
Lachnea hemisphaerica (Wigg.) Gillet *A.*
Ciliaria (=Lachnea) scutellata (Linn.) Quél. *C.*, *F.*, *R.*, umbrorum (Fr.) Boud. *F.*
Perrotia (=Dasyscypha) flammea (A. & S.) Boudier *R.*
Coprobia (=Humaria) granulata (Bull.) Gillet *Cl.*, *F.*, *R.*, *S.*
Ascobolus stercorarius (=furfuraceus) (Bull.) Schröt., *G.*, *S.*
Pyronema (=Humaria) omphalodes (Bull.) Sacc. *R.*
Geoglossum ophioglossoides (=glabrum) (Linn.) Sacc. *A.*, *C.*, *D.*
Microglossum arenarium Rostr. *Culbin Sandhills.*
Spathularia clavata (Schaeff.) Sacc. *R.*
Mitrula cucullata (Batsch) Fr. *A.*
Leotia lubrica (Scop.) Fr. *A.*, *F.*, *R.*
Cudoniella (=Leotia) acicularis (Bull.) Schröt. *A.*, *F.*
Ombrophila clavus (A. & S.) Fr. *A.*, *C.*, *G.*
Calycella (=Helotium) citrina (Hedwig) Boud. *C.*
Melachroia (=Humaria) xanthomela (Pers.) Boud. *A.*
Coryne sarcoides (Jacq.) Tul., urnalis (Nyl.) Sacc. *Cl.*, *F.*, *G.*, *R.*, *S.*
Bulgaria inquinans (=polymorpha) (Pers.) Fr. *F.*, *G.*
Corynella (=Coryne) atrovirens (Pers.) Boud. *A.*, *C.*
Polydesmia (=Belonidium) pruinosa (B. & Br.) Boud. *G.*, *R.*,
Calloria fusarioides (Berk.) Fr. *F.*
Orbilia leucostigma Fr. *C.*, *Cl.*, xanthostigma Fr. *A.*, *G.*
Sclerotinia Curreyana (Berk.) Karst. *Culbin Sandhills*, *D.*, *R.*, *the sclerotium in fading culms of Juncus.*
Phialea firma (Pers.) Boud. (=Ciboria ochroleuca (Bolt.) Massee) *G.*, *R.*
Chlorosplenium aeruginosum (Oed.) Fr. *G.*
Helotium herbarum (Pers.) Fr. *A.*, *G.*, fructigenum (Bull.) Karst. *C.*, *G.*, epiphyllum (Pers.) Fr. *A.*, *C.*, virgultorum (Vahl.) Karst. *Cl.*, *F.*, cyathoideum (Bull.) Karst. *A.*, *C.*, *R.*
Dasyscypha virginea (Batsch) Fckl., nivea (Hedw. fil.) Sacc. *A.*, *Cl.*, crucifera (Phil.) Sacc. *R.*, ciliaris (Schrad.) Sacc. *C.*, acuum (A. & S.) Sacc. *A.*
Erinella apala (B. & Br.) Massee *R.*
Lachnella (=Dasyscypha) sulfurea (Pers.) Quél. *A.*
Trichoscypha (=Dasyscypha) calycina (Schum.) Fckl. *R.*
Hyaloscypha (=Dasyscypha) hyalina (Pers.) Boud. *A.*, *Cl.*, *G.*
Pyrenopeziza (=Pseudopeziza) arenivaga (Desm.) Sacc. *Culbin Sandhills*, *Cl.*, *F.*, *S.*, *on Ammophila*, rubi (Fr.) Rehm. *R.*
Mollisia cinerea (Batsch) Karst., melaleuca (Fr.) Sacc. *A.*, *C.*
Cenangium abietis (Pers.) Rehm. *Cl.*, *F.*, *S.*
Scleroderris rubi (Lib.) Mass. *Cl.*, *F.*, *S.*

Trochila laurocerasi (Desm.) Fr. *Cl.*, *F.*, *G.*, *S.*
Propolis faginea (Schrad.) Karst. *A.*, *Cl.*
Stictis junci Karst. *Cl.*, *F.*, *S.*
Phacidium calthae Phil. *Cl.*, *F.*, *S.*
Pseudopeziza ranunculi (Wallr.) Fckl. *Cl.*, *F.*, *G.*, *S.*
Stegia ilicis Fr. *C.*, *Cl.*, *F.*, *S.*
Colpoma quercinum (Pers.) Wallr. *G.*, *R.*
Rhytisma acerinum (Pers.) Fr., salicinum (Pers.) Fr. *Cl.*, *Culbin Sandhills*, *F.*, *S.*
Dichaena quercina (Pers.) Fr. *G.*, *R.*
Lophodermium pinastri (Schrad.) Chev. *A.*, *C.*, *Cl.*, *F.*, *G.*, *R.*, arundinaceum (Schrad.) Chev. *Culbin Sandhills*, cladophilum (Lév.) Rehm *G.*, juniperinum (Fr.) de Not. *G.*, *R.*
Elaphomyces variegatus Vitt. *A.*, *C.*, *D.*
Cystopus candidus (Pers.) Lév. *Cl.*, *F.*, *R.*, *S.*
Phytophthora infestans (Mont.) de Bary *Cl.*, *F.*, *S.*
Plasmopara nivea (Ung.) Schröt. *Cl.*, *F.*, *S.*
Peronospora calotheca de Bary *Cl.*, *F.*, *S.*, parasitica (Pers.) de Bary, *Cl.*, *F.*, *S.*
Protomyces macrosporus Ung. *Cl.*, *F.*, *S.*, pachydermus Thüm. *Cl.*, *F.*, *S.*
Phyllosticta sambuci Desm. *Cl.*, *F.*, *G.*, *S.*, ulmi West. *Cl.*, *F.*, *S.*, mercurialis Desm. *Cl.*, *F.*, *S.*
Phoma samararum (Desm.) Sacc. *C.*, *on Ash samaras*, deusta Fckl. *F.*, *on Rhinanthus.*
Cytispora Curreyi Sacc. *Cl.*, *F.*, *S.*, *on Larix*, lauro-cerasi Fckl. *Cl.*, *F.*, *S.*, var. ramulorum Sacc. *Cl.*, *F.*, *S.*
Darluca filum (Biv.) Cast. *G.*
Diplodina ammophilae Trail *Culbin Sandhills.*
Septoria gei Rob. & Desm. *Cl.*, *F.*, *S.*, stellariae Rob. & Desm. *Cl.*, *F.*, *S.*, petroselini Lib. *Cl.*, *F.*, *S.*, stachidis Rob. & Desm. *Cl.*, *F.*, *S.*, scabiosicola Desm. *Cl.*, *F.*, *G.*, *S.*, urticae Desm. & Rob. *Culbin Sandhills*, rosae (Desm.) Sacc. *G.*
Phleospora aceris (Lib.) Sacc. *G.*
Leptostroma juncacearum Sacc. *C.*, *on Luzula sylvatica* (teste Dr. J. W. Ellis).
Leptothyrium periclymeni (Desm.) Sacc. *Cl.*, *F.*, *S.*, alneum (Lév.) Sacc. *Cl.*, *F.*, *S.*
Discella carbonacea (Fr.) B. & Br., *Cl.*, *F.*, *S.*
Gloeosporium tiliae Oud. *G.*, fagi Desm. & Rob. *Cl.*, *F.*, *S.*, salicis West. *Cl.*, *F.*, *S.*
Libertella faginea Desm. *G.*
Melanconium bicolor Nees *Cl.*, *F.*, *G.*, *S.*, sphaeroideum Link *Cl.*, *F.*, *G.*, *S.*
Asterosporium Hoffmanni Kunze *Cl.*, *F.*, *S.*

Cylindrium flavovirens Bon. *Cl.*, *F.*, *S.*
Oidium erysiphoides Fr. *Cl.*, *F.*, *S.*, alphitoides Griff. & Maulb. *A.*, *C.*, *Cl.*, *F.*, *S.*, monilioides Link *R.*
Trichoderma lignorum Tode *A.*, *C.*, *Cl.*, *F.*, *G.*, *R.*, *S.*
Ovularia rufibasis (B. & Br.) Mass. *R.*, veronicae (Fckl.) Sacc. *Cl.*, *F.*, *G.*, *S.*, obliqua (Cke.) Oud. *Cl.*, *F.*, *G.*, *S.*
Sepedonium chrysospermum (Bull.) Fr. *A.*, *C.*, *G.*
Didymaria didyma (Ung.) Schröt. *Cl.*, *F.*, *S.*
Ramularia violae Trail, *on Viola sylvestris*, *Cl.*, *F.*, *G.*, *S.*, Winteri Thüm., *on Ononis*, *Cl.*, *Culbin Sandhills*, *F.*, *S.*, heraclei Sacc. *Cl.*, *F.*, *G.*, *S.*, valerianae (Speg.) Sacc. *Cl.*, *F.*, *S.*, knautiae (Massal.) Bub. *Cl.*, *F.*, *S.*, *on Scabiosa arvensis*, lampsanae (Desm.) Sacc. *Cl.*, *F.*, *S.*, taraxaci Karst. *Cl.*, *F.*, *S.*, variabilis Fckl. *Cl.*, *F.*, *S.*, *on Digitalis*, calcea (Desm.) Ces. *Cl.*, *F.*, *G.*, *S.*, *on Nepeta glechoma*, ajugae Niessl. *G.*, plantaginis Ellis & Mart. *Cl.*, *F.*, *S.*, plantaginea Sacc. & Berl. *Cl.*, *F.*, *S.*, pratensis Sacc. *Cl.*, *F.*, *G.*, *S.*, urticae *Ces.* *Cl.*, *Culbin Sandhills*, *F.*, *S.*
Zygodesmus fuscus Cda *R.*
Fusicladium pirinum Fckl. *Cl.*, *F.*, *S.*, depressum B. & Br. *Cl.*, *F.*, *S.*
Cercospora mercurialis Pass. *Cl.*, *F.*, *S.*
Coniothecium amentacearum Cda. *Cl.*, *F.*, *S.*, betulinum Cda. *Cl.*, *F.*, *S.*
Fumago vagans Pers. *G.*
Stilbella erythrocephala (Ditm.) Lindau *Cl.*, *F.*, *S.*
Isaria arachnophila Ditm. *A.*
Tubercularia vulgaris Tode *A.*, *G.*
Aegerita candida (Pers.) Grev.

MYCETOZOA FOUND DURING THE FUNGUS FORAY IN THE FORRES DISTRICT, SEPT. 12th TO 20th, 1912, WITH THE DESCRIPTION OF A NEW SPECIES.

PLATE I.

By Gulielma Lister, F.L.S.

After a wet summer the week of the Fungus Foray was one of almost continuous fine weather. These conditions seem to have been extremely favourable for the Mycetozoa. The wet months encouraged the development and growth of their "plasmodium" stage, and the succeeding dry weather caused many species to pass into the sporangium-stage. Apart from the favourable season, however, there can be no doubt that this district of Scotland, with its ancient pine forests and extensive mixed woods, is remarkably prolific in these organisms. During the seven days of our search, eighty-one species were found, one of which appears to be new, while thirteen others had not before been recorded for Scotland and are what we have been accustomed to consider as rare.

In the succeeding list of the species found, the localities we visited are referred to by the following abbreviations:—

A. Altyre Woods (pine, spruce, larch, oak, ash, birch, &c.).
C. Cawdor Woods (spruce, pine, oak, holly, &c., with an undergrowth of whortleberry, grass and fern).
Cul. Culbin Sands (pine woods).
D. Darnaway Woods (oak and spruce).
F. Woods on right bank of Findhorn, between Sluie and Divie Bridge (pine, spruce, oak, lime, &c.).
G. Glenferness Woods (pine, spruce, birch, &c.).
R. Rothiemurchus Forest (pine woods, with undergrowth of whortleberry, and a little boggy ground).
* Indicates a new record for Scotland.

Ceratiomyxa fruticulosa (Muell.) Macbr. C.

Badhamia capsulifera (Bull.) Berk. A., C., F. Found on lichen and bark on both dead and living oak boughs.

B. utricularis (Bull.) Berk. G.

B. rubiginosa (Chev.) Rost. var. *globosa* D.

**Physarum mutabile* (Rost.) Lister, F. On a twig among moss under spruce trees.

P. viride (Bull.) Pers. A.

P. auriscalpium Cooke. F. A cluster of five sporangia matured on moss from orange-yellow plasmodium. This is the second British gathering of the species, the first having been made by the Rev. W. Cran a few weeks before near Skene, Aberdeen, on mossy trunks of living trees.

P. nutans Pers. A., C., Cul., D., F., G., R. Both the type and var. *leucophaeum* were abundant.

P. compressum Alb. & Schw. C. On dead leaves and grass.

**P. conglomeratum* (Fr.) Rost. C. Abundant on holly leaves and grass. This species is distinguished by microscopic characters only from its near ally *P. contextum* Pers., viz., by the peculiar structure of the sporangium-wall, and by the smaller smoother spores.

P. virescens Ditm. var. *obscurum* Lister C. On holly leaves. This variety has only once before been recorded from Scotland. Prof. I. B. Balfour found it near Moffat in 1887.

Fuligo septica Gmel. A., C., Cul., F., G., R. Many conspicuous bright yellow aethalia, some as much as nine inches in diameter, were seen on sawdust mounds by saw-mills at Aviemore and the Culbin Sands.

**F. muscorum* Alb. & Schw. A. Found as apricot-coloured plasmodium, which matured to inconspicuous yellowish-grey aethalia after a few days.

**F. cinerea* (Schw.) Morgan var. *ecorticata* Lister C., R. Found as white plasmodium, and matured indoors.

Craterium minutum (Leers) Fries. A., C., Cul., G., R.

C. leucocephalum (Pers.) Ditmar. A., C.

C. aureum (Fr.) Rost. A. On lichen on the underside of an oak bough. The sporangia are more globose than usual, and the capillitium has more of a *Badhamia* character, the large pale yellow branching lime-knots being connected by few and short hyaline threads. The only other Scotch record that we have of this species seems to be a gathering made by Capt. Carmichael at Appin at least forty years ago.

Leocarpus fragilis (Dickson) Rost. A., C., Cul., F., G., R.

Diderma spumarioides Fr. C. On holly leaves; a small form, with scanty hypothallus.

D. effusum (Schw.) Morg. F. Abundant on heaps of dead brushwood, where the net-like plasmodiocarps extended over several square inches.

**D. ochraceum* G. F. Hoffm. F. Found on moss under larches as lemon-yellow plasmodium, and matured indoors. The only other British locality we know for this species is North Wales.

D. radiatum (L.) Lister. A., R.

D. niveum (Rost.) Macbr. var. *deplanatum* Lister. F.

**D. asteroides* Lister. C., F. In the Cawdor woods the dark purple-brown sporangia were found in great abundance on dead holly leaves; it was also found maturing from white plasmodium. In the Altyre woods it occurred on moss and fir-needles. These, and a small gathering on *Equisetum* stems, made by Mr. W. H. Burrell in Norfolk in February, 1911, are the only British records of the species we know of. This is the first knowledge we have of the colour of the plasmodium.

**Didymium dubium* Rost. C. On holly leaves. This species has till now only been recorded from the South of England and Bohemia. The flat white sporangia are perhaps overlooked, or mistaken for *D. difforme.*

D. difforme (Pers.) Duby. C.

D. melanospermum (Pers.) Macbr. A., C., Cul., F., R.

D. nigripes Fries. A., C., Cul., F.

D. clavus (Alb. & Schw.) Rost. C.

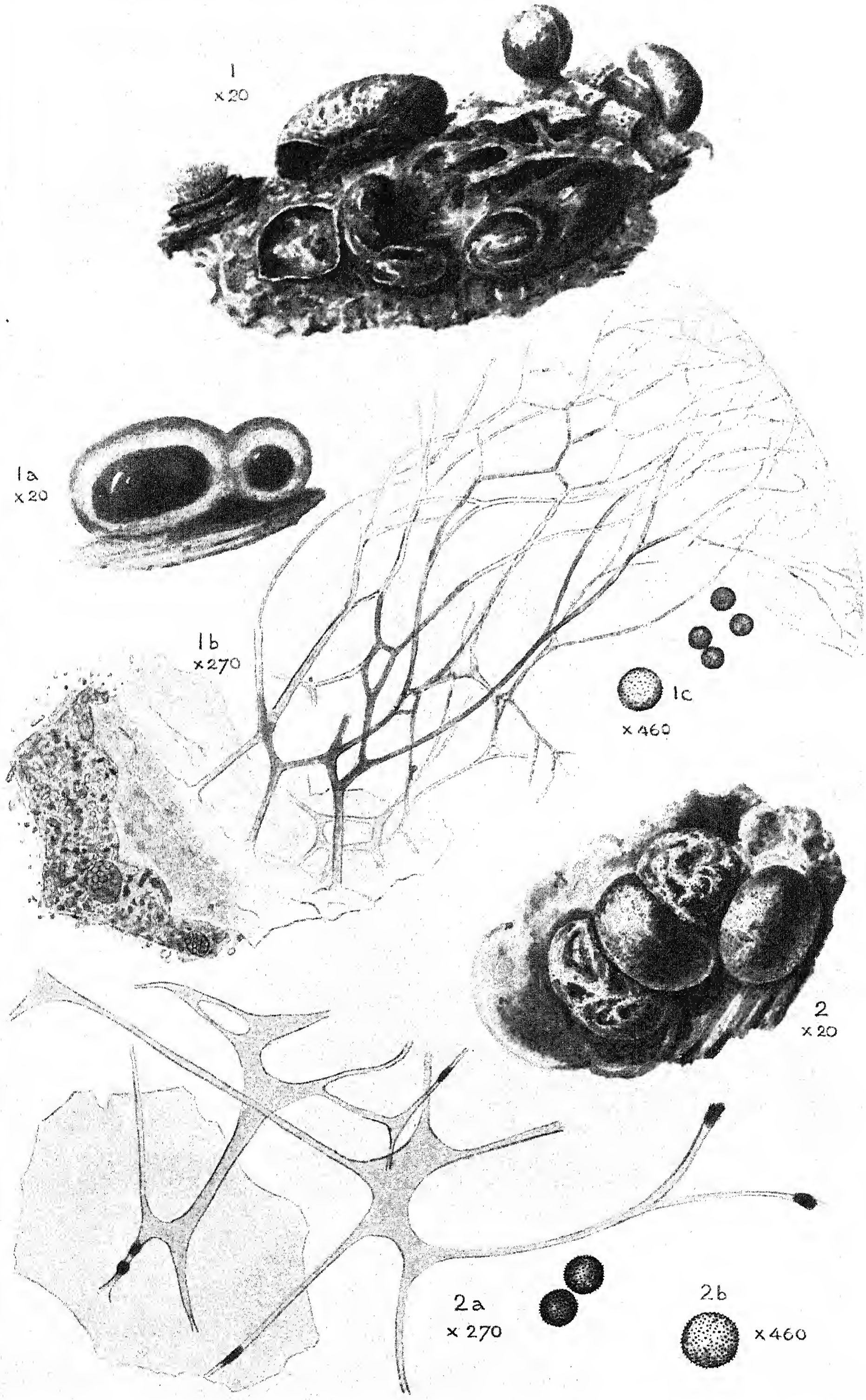
D. squamulosum (Alb. & Schw.) Fries. A., C.

Mucilago spongiosa (Leysser) Morg. C., R.

Lepidoderma tigrinum (Schrad.) Rost. C., R. Found on Sphagnum and stumps of Conifers.

**Leptoderma iridescens* G. Lister (Journ. Bot. LI., 1). C., R. On pine bark and sticks. This species was first found in Bedfordshire in March, 1892; it was again found in that county in December, 1894, and November, 1911. In the autumn of 1912 it was obtained from Mürren and the Jura Mountains in Switzerland, and now we have it in Scotland from two woods twenty miles apart. The membranous walls of the sporangium often include near the base, besides dark granular matter, minute scales of calcium carbonate; these scales are wanting in the Scotch gatherings.

Colloderma oculatum (Lippert) G. Lister. Pl. I, figs. 1, 1a to c. C. R. On fallen pine wood. This species was first described in 1894 under the name *Didymium oculatum* by Christian Lippert, from sporangia that appeared on wood kept moist in his laboratory in Vienna. It does not appear to have been noticed again till the autumn of 1911, when the Rev. W. Cran discovered the minute inconspicuous sporangia on mossy wood, near Skene, Aberdeenshire. Since then it has been



C. Lister del. West, Newman proc.

1, 1a–c. COLLODERMA OCULATUM (*Lippert*) *G. Lister*.
2, 2a, b. LAMPRODERMA INSESSUM *G. Lister*.

obtained from a number of widely separated localities: from Epping Forest, Essex, where it has twice been found on moss and lichens on living oak trees, from the Jura Mountains and Mürren, Switzerland from Portugal, from New England, and from Japan. Lippert describes minute granules of calcium carbonate being present among the refuse matter clothing the sporangium-wall; these granules have not been observed in any of the later gatherings, and it seems probable that he was mistaken. If this was the case the genus *Colloderma* does not belong to the subcohort *Calcarineae* (where it was placed provisionally in "Mycetozoa," ed. 2), but should be included among the *Amaurochaetineae*, although it differs from all other genera of that subcohort in the remarkable gelatinous layer in which the sporangia are more or less enveloped.

Stemonitis fusca Roth. A., C., Cul., F., G., R.

S. flavogenita Jahn. R.

S. confluens Cooke & Ellis. R. Matured from white plasmodium.

Comatricha nigra (Pers.) Schroet. A., C., Cul., F., R.

**C. laxa* Rost. C., R.

**C. pulchella* (Bab.) Rost. var. *tenerrima* Lister. C.

C. typhoides (Bull.) Rost. C.

C. typhoides var. *heterospora* Rex. G., R.

**C. rubens* Lister. C.

**C. lurida* Lister. C. On holly leaves. This species has only been obtained before from the South of England.

Enerthenema papillatum (Pers.) Rost. C., G.

Lamproderma echinulatum Rost. C. A large development on an old fir stump. This rare species has only once before been recorded from Scotland, when Prof. I. B. Balfour collected it near Moffat in 1886.

L. columbinum (Pers.) Rost. C.

L. violaceum (Fr.) Rost. R.

L. insessum n. sp. (Pl. I, figs. 2, 2a, b). Plasmodium? Sporangia clustered, subglobose or forming short plasmodiocarps, 0·8 to 1 mm. diam., sessile, dark purple-brown, shining with iridescent reflections: sporangium-wall membranous, pale purple. Columella none. Capillitium of scanty simple or sparingly-branched pale purplish threads 2 to 5μ diam., sometimes with wide expansions at the axils and darker knot-like thickenings. Spores dark brownish-purple, closely spinulose, 18 to 19μ diam. Habitat. On lichen, on the trunk of a living sycamore (*Acer Pseudoplatanus* L.), five feet

from the ground. Altyre woods, near Forres. Only a single specimen, consisting of a cluster of five sporangia, was found of this species. It differs from all other species of *Lamproderma*, except some alpine forms of *L. Lycopodii* Raunk., in being entirely without stalk and columella. The spores resemble those of *L. echinulatum* Rost. in their large size, but, instead of being studded with strong scattered spines, they are closely spinulose all over. In three sporangia examined the capillitium is scanty and either pale purple or colourless. The specific name *insessum* is given from the sporangia being *perched* on the trunk of a tree.

Amaurochaete fuliginosa (Sow.) Macbr. Cul.

Brefeldia maxima (Fr.) Rost. A.

Lindbladia effusa (Ehrenb.) Rost. R.

Cribraria argillacea Pers. Cul.

C. macrocarpa Schrad. C. An extensive growth of metallic slate-grey plasmodium was found emerging to form sporangia over the greater part of an old spruce stump. Specimens carefully protected matured perfectly in the course of a few days. The only other British specimen of this handsome species recorded is a gathering made by the Rev. J. Stevenson at Glamis, Forfarshire, about forty years ago.

C. rufa (Roth) Rost. R.

C. aurantiaca Schrad. Cul.

Dictydium cancellatum (Batsch) Macbr. Cul., R.

" " var. *fuscum* Lister. R.

Licea flexuosa Pers. A., Cul., G., R.

L. pusilla Schrad. R. On pine wood. The only previous British record we had of this species is of a gathering made at Glamis by the Rev. J. Stevenson. It was also found last November near Weybridge, Surrey.

L. minima Fr. R. On pine wood. This minute species was first obtained in the British Isles by the Rev. W. Cran, who found it near Aberdeen in November, 1911.

Enteridium olivaceum Ehrenb. A., C. A specimen collected by Mr. Cheesman in Cawdor woods in immature rosy condition matured into perfect olive-brown aethalia. The pseudocapillitium consists not only of the usual broad membranous strands but also of slender threads like those seen always in *Reticularia Lycoperdon* Bull., and occasionally in *Enteridium Rozeanum* Wing.

Tubifera ferruginosa Gmel. A., C., Cul., F., R. Very abundant on stumps of conifers.

Lycogala epidendrum (L.) Fr. A., C., F., G., R.

Trichia persimilis Karsten. A., C., Cul., G., R.

T. verrucosa Berk. A., C. This appears to be the second Scottish gathering, the first having been made near Moffat in 1886 by Prof. I. B. Balfour.

T. contorta (Ditm.) Rost. C., R.

T. varia Pers. A., C., Cul., D., F., G., R.

T. decipiens (Pers.) Macbr. A., F., Cul., R. The young coral-red sporangia of this species and of *Tubifera ferruginosa* made conspicuous patches of colour on sawdust mounds at Aviemore and the Culbin Sands.

T. Botrytis Pers. A., C., Cul., F., G., R.

Arcyria ferruginea Saut. A.

A. denudata (L.) Sheldon. A., C., F.

A. incarnata Pers. A., C., Cul., F., R.

A. cinerea (Bull.) Pers. A., C., G.

A. nutans (Bull.) Grev. G.

**Lachnobolus congestus* (Somm.) Lister. A small cluster of about twenty shining flesh-coloured sporangia was found on a plank at Aviemore.

Perichaena corticalis (Batsch) Rost. R., A.

Margarita metallica (Berk. & Br.) Lister. R.

**Dianema depressum* Lister. G. A quantity of the white plasmodium was found emerging to form sporangia from the end of an old ash log sodden with moisture. Some older sporangia had already assumed a metallic-violet tint; after being kept moist for a week they became mature and lilac-brown in colour.

D. corticatum Lister. C., Cul., R.

Hymenobolus parasiticus Zukal. C.

DESCRIPTION OF PL. I.

1. *Colloderma oculatum.* A group of seven sporangia; four are unbroken; in one (above) the upper part of the wall is separating from the lower part in a lid-like way; in another (to the left) the upper wall and spores have fallen away exposing the brush of capillitium that arises from the central part of the floor of the sporangium; below this the bare base of another sporangium is seen from which the capillitium and spores have fallen away.

1a. Two sporangia, wet; the gelatinous outer layer has swollen up and the dark mass of spores is seen through its translucent wall.

1b. Spores and capillitium attached above and below to the membranous sporangium wall; to the left below is seen a fragment of the outer wall with deposits of refuse matter.

1c. Spore, highly magnified.
2. *Lamproderma insessum.* A group of four sporangia on lichen.
2a. Capillitium and spores with fragment of sporangium-wall.
2b. Spore, highly magnified.

PRESIDENTIAL ADDRESS.

By Gulielma Lister, F.L.S.

THE PAST STUDENTS OF MYCETOZOA AND THEIR WORK.

When I was engaged in the task of revising the Nomenclature of the Mycetozoa with the view of adopting the earliest reliable specific names I had occasion to consult a number of the older books that deal with these organisms. I soon became much interested in the writers of these books, and could not but be often impressed by the faithful and beautiful work they accomplished, with very simple appliances, and with little assistance from those who had lived before to guide them.

I have put together a short account of the progress of the study of Mycetozoa, and have added notes on the lives of some of those whose observation and insight have in the past cleared away so many difficulties for us.

If Mycetozoa were observed at all by the earlier Naturalists, they were considered to be Fungi, and Fungi were regarded as objects of superstition and mystery, rather than as living plants.

Writing in the second half of the 16th century, the German herbalist Hieronymus Bock gave expression to the opinion of the times when he writes, in his chapter on Fungi: "Mushrooms are neither herbs nor roots, neither flowers nor seeds, but merely the superfluous moisture of the earth and trees, of wood and other rotten things."

Again, the Italian botanist Cesalpino, whose philosophical views on the importance of the *fructification* induced a great advance in the method of classifying flowering plants, writes in 1583: "Some plants have no seed: these are the most imperfect, and spring from decaying substances: they have only to feed themselves and grow, and are unable to produce their like:

they are a sort of intermediate existences between plants and inanimate nature."

At the beginning of the 18th century a more scientific spirit was awakening.

One of the first references that we have to any species of the Mycetozoa is that given by the French botanist *Joseph Pitton de Tournefort*, the man to whose genius we owe the first classification of plants in clearly-defined genera. Writing in the year 1700 in his book entitled "Institutiones Rei Herbariae" (or "Arrangement of Plants") he described among the Puff-Balls, a "*Lycoperdon sanguineum sphericum*," which later writers are probably right in thinking referred to the young rosy aethalia of *Lycogala epidendrum* (L.) Fr.

The first detailed description of a species of this group we find in an account given in 1727 of "the Flowers of Tan," "Les Fleurs de la Tannée" (or *Fuligo septica* Gmel. as we now call it) by the Frenchman Jean Marchant (son of the Nicholas Marchant after whom the Liverwort "*Marchantia*" was named). This paper is entitled (translated) "On a remarkable growth which appears on the bark of the Oak beaten and reduced to powder, commonly called Tan." After describing the beautiful pale-yellow foam-like masses that unaccountably appear on heaps of spent Tan, he goes on to say that "after a few days vegetation ceases; it condenses and forms a golden-yellow crust beneath which is a very fine black powder, like that of *Lycoperdon*." This he thinks may be "the Tan dissolved and reduced to impalpable powder." He accounts for the appearance as the result of the fermentation of the Tan soaked in exhalations from hides treated there, and aided by the air. He says, "As it has neither roots, leaves, flowers or seeds it bears more relation to sponges than to any other plant." (Sponges were then considered to be plants). He therefore names it "*Spongia fugax, mollis, flava et amoena, in pulvere coriario nascens*," "A sponge fugacious, soft, yellow and pleasing, appearing on powdered Tan."

Two years later we meet with a great advance in the treatment of Fungi, and with them of the Mycetozoa. This we owe to the Italian botanist Pier Antonio Micheli. Micheli was born at Florence in 1679. His parents were poor and cared little for their son's education. But his thirst for knowledge, and especially of natural knowledge, was insatiable. He taught himself Latin, and became so proficient in botany that he gained royal favour and was appointed botanist to the Grand Duke of Tuscany, with the charge of the public gardens in Florence. This post he held till his death in 1737.

It is interesting to compare the various estimates of Micheli's work that have come down to us. Dr. William Sherard of

Oxford, founder of the Sherardian chair of botany in the University, knew Micheli well and had much correspondence with him; he held him in high esteem, and writes of him "no man is more exact and faithful than he is." Micheli is described by his contemporary the Swiss botanist Haller as "a gardener, illiterate and poor, but most studious of wild plants, and a great investigator of Fungi, Mosses, Lichens and Grasses." The distinguished Swedish mycologist Fries, writing in 1829, describes the dark chaos that reigned with regard to any recognition of the Myxogastres (as he calls the Mycetozoa) "until the immortal Micheli kindled such a brilliant light that his immediate successors were not able to bear it." In our own day Prof. Vines writes of Micheli's work being of peculiar interest in that it contains the earliest results of the application of the microscope to the study of Cryptogams, and of his being the first to discover the fact that the spores of Fungi are capable of germinating and reproducing the plant.

Micheli's great work, published in 1729, is entitled (translating from the Latin) "New genera of Plants, arranged after the method of Tournefort, in which 1900 plants are enumerated, of which 1400 have not before been observed, while others are referred to their proper places: with additional notes and observations regarding planting, origin and nutriment of fungi, mucors and allied plants." It is a handsome quarto volume with bold and spirited illustrations.

The Fungi are arranged in genera, which are divided again into subgenera or "*ordines*," carefully defined by natural characters. In the division of Fungi defined as "very simple plants containing seeds in the inner part" we meet with four genera that refer to Mycetozoa. Under the names *Clathroides* and *Clathroidastrum* we have undoubted descriptions of *Arcyria* and *Stemonitis* respectively. The figures, although rather diagrammatic, show the characters of the elastic capillitium and persistent cup of *Arcyria*, and the long columella and network of capillitium of *Stemonitis*. Under the new genus *Lycogala* are described five species, including our *Lycogala epidendrum* (L.) Fr. and *Reticularia Lycoperdon* Bull. Under *Mucilago* Micheli describes nine species seen occurring in a mucilaginous state: most of the descriptions refer to young sporangia, but in his "*white branched Mucilago resembling the roots and fibres of trees*" we have the earliest mention of a network of creeping plasmodium. Amongst the other species of *Mucilago* we recognize with the aid of the illustrations, *Fuligo septica* (L.) Gmel., *Mucilago spongiosa* (Leyss.) Morg. and immature sporangia of probably *Physarum*, *Didymium* and *Comatricha*. The description and illustration of *Puccinia*

ramosa &c., undoubtedly refer to *Ceratiomyxa fruticulosa* (Muell.) Macbr.

At this time, of course, no separate specific names had yet been given: each species could only be referred to by quoting the whole description, and was therefore expressed in as few words as possible; thus what we take to be *Arcyria denudata* (L.) Sheldon is described as *Clathroides purpureum pediculo donatum*," or "the purple Clathroides provided with a stalk," and what is probably a sessile *Trichia*, as "*Clathroides flavescens pediculo carens*" or "the yellow Clathroides without a stalk." Short notes with fuller characters and references to localities were often added, but the object of the writer is simply to distinguish one species from another, and not to aim after a critical description.

Following on the lines laid down by Micheli, Albrecht von Haller,* the great Swiss anatomist and physiologist, also a botanist, poet and patriot, published in 1742 "A systematic and descriptive List of Plants indigenous to Switzerland." It is dedicated to Frederick, Prince of Wales, eldest son of our George II., to whom Haller had been appointed physician. The two folio volumes are profusely and carefully illustrated. The Swiss Mycetozoa appear in the same genera as those given by Micheli, with the addition of two new ones, *Embolus* and *Sphaerocephalus*, which contain in the light of our present knowledge a curious assemblage of species of *Physarum*, *Comatricha*, *Trichia* and others. Haller's caution is shown by the way Micheli's genus *Clathroides* is referred to doubtfully as "*An Clathroides*." Amongst the five species described under this questionable genus we have an undoubted description and illustration of *Hemitrichia Vesparium*.

A further and fuller account of the plants of Switzerland was published by Haller twenty years later, in 1762. During these twenty years he had found time in his amazingly active life to make almost yearly pilgrimages to study the flora of different parts of his native land, reference to which is made in his preface. He writes of having especially consulted the works of Linnaeus; but the Linnaean classification was too artificial to please him, and he does not adopt the binomial nomenclature. In this volume Haller creates a new genus *Trichia* to include some of the Mycetozoa, but it is far from being the *Trichia* as we now define it, and not only brings together species having little natural affinity, but serves to obscure the more natural classification of Micheli.

From the painstaking and concise writing of Haller we turn to the work of his contemporary, our fellow-countryman Dr.

* Born 1708; died 1777.

John Hill* (knight of the Swedish Order of the Polar Star) whose "History of Plants," published in 1751, forms a section of a larger work entitled "A General Natural History, or New and Accurate Descriptions of the Animals, Vegetables and Minerals of the Different parts of the World," &c., &c. Hill's descriptions are often picturesque but he permits his theories to over-rule his facts. He is determined to recognize male and female flowers even in the obscure Fungi. Among the Mycetozoa, his new and artificial genus *Arcyria* unites our present *Arcyria* with *Trichia* and *Stemonitis*. It is defined in the following mysterious terms:—"*Arcyria*, a genus of fungusses consisting of a head of a reticulated structure, not hollow, arising out of a case or volva containing distinct male and female flowers: the male are of oblong anthers only, arranged together by fours in the summit of the same filament which adheres to the ridges of the reticulation. The female flower we see no part of but the seeds which are small and of an oval figure." After describing three species with some care, giving ample details as to where he has found them, he disposes of the remaining species with the light touch familiar to him. He says: "'The three other species are easily distinguished by their names, the yellow *Arcyria* without pedicles, the black very small *Arcyria* with short pedicles, and the deep brown *Arcyria* with shorter heads." His new genus *Physarum* is equally artificial.

The above definitions seem absurdly inadequate, but they bring home to us the immense advantage that came with the introduction of the binomial system of nomenclature, when by the adoption of separate specific names there was no longer any object in limiting the descriptions to a few words, but each author was free to make them as full and detailed as he wished.

We now come to the time of Linnaeus.† His life is well known to us,—his happy childhood in a beautiful part of the south of Sweden, where his father, the pastor of a country parish, and his mother, both fostered his love of nature;—his strenuous days as a medical student at the Universities of Lund and Upsala, when in spite of poverty, his indomitable energy and enthusiasm for the study of living things triumphed over all difficulties,—his genius for making friends and attracting disciples who assisted him in his labours, his prosperity and fame as his powers became recognized at home and abroad, and, finally—the last years of his life marred by ill-health,—all these are familiar to us.

When we try to realize the vast amount of labour undertaken by Linnaeus in gathering together the work of his predecessors

* Born 1716; died 1775.
† Born 1707; died 1778.

on all living creatures, in studying them himself to some extent, in classifying them and applying to them his method of binomial nomenclature, it is perhaps not surprising that the little-known group of Fungi should have received but slight attention at his hands. We learn moreover from Fries that Linnaeus had a strong preference for flowering plants, and took little interest in Fungi, which he regarded as "a pack of rovers, robbing what Flora leaves when she retires to her winter quarters." In the second edition of his "Species Plantarum," published in 1763, 1,515 pages are devoted to Phanerogams, and only 17 pages to Fungi; seven species of Mycetozoa are very briefly described under the fungus genera *Lycoperdon*, *Clathrus* and *Mucor*.

The work of Linnaeus however, with its widespread influence and the criticism it evoked, gave an immense impetus to the study of botany. Most of the botanists of the later years of the eighteenth century followed their master in devoting themselves chiefly to describing and classifying flowering plants.

Of those who wrote on Fungi, and with them, on Mycetozoa, the following may be mentioned,—Giovanni Antonio Scopoli,* the Tyrolese botanist and mineralogist, author of "Flora Carniolica"; and Jakob Christian Schäffer,† author of an illustrated work on the Fungi of Bavaria, in three volumes, where six Mycetozoa are mentioned under the genus *Mucor*.

There are four men, however, whose names should be especially remembered in connection with Mycetozoa for the good work they did in description and illustration;—they are Adolph Batsch, Pierre Bulliard, Heinrich Schrader and Charles Persoon.

A. J. G. K. Batsch was born in 1761 at Jena, where he became a professor in the University, and where he died at the age of 41. When only 22 he published his "Elenchus Fungorum" or "Treatise on Fungi," giving an account of the Fungi found in the neighbourhood of Jena. The descriptions, written in parallel columns of German and Latin, are accompanied by carefully drawn coloured engravings of some of the more interesting species, among which we recognize eight species of Mycetozoa. The illustrations of "Mucor cancellatus" (*Dictydium cancellatum* (Batsch) Macbr., as we now call it) are especially good. The account and figure of *Hemitrichia Vesparium* (Batsch) Macbr., described as "*Lycoperdon Vesparium*, der zellige rothe Wollenschwam" are also convincing.

Pierre Bulliard was born at Aubepierre, France, in 1742. The first part of his celebrated "Histoire des Champignons de la France" appeared in 1791. Two years later he died, and

* Born 1723; died 1788.
† Born 1718; died 1790.

the remainder of the work was published posthumously. It consists of a thick quarto volume of text, with accompanying volumes of coloured plates. Fungi are here divided into four classes, according to whether the spores are produced within the fruiting body, or all over its surface, or on the upper part only or over the lower part only. Mycetozoa are placed among the Puff-balls in the first class, having spores produced internally. They appear under four genera, *Lycoperdon* and *Sphaerocarpus*, *Reticularia* and *Trichia:* the two latter are recognized as developing from a soft juicy condition, but *Sphaerocarpus* is described as not being mucilaginous in youth. In the light of what we know now the classification is valueless, and the thirty odd species described are arranged in hopeless confusion as regards natural relationship; but when we turn to the plates our estimation of the importance of Bulliard's book at once rises. The illustrations are in many cases so excellent that the species depicted can be identified with certainty. Thus we have in "Champignons de la France" a standard work which has been referred to by all later writers on fungi, and which it is impossible rightly to ignore.

Heinrich Adolph Schrader was born at Hildesheim in 1767. He became professor of botany at Göttingen, and wrote several books on flowering plants. But the work that interests us here is his "Nova Genera Plantarum," published in 1797. The new genera he describes all refer to Mycetozoa; they are *Cribraria*, *Dictydium*, *Licea*, *Didymium*, all of which we still retain with some slight alteration of definition at the present time. He remarks that although these plants are usually placed with the fungi, they all develop from a pulpy and mucilaginous condition. His descriptions of twenty-seven species included under the four genera show a great advance on the work of previous authors. Schrader had, no doubt, the benefit of the advice of Persoon, who was twelve years his senior, and whom he describes as being most friendly to him, "*amicissimus Persoonius*."* The way in which he deals with the puzzling genus *Cribraria* is masterly, and the characters of the species described are on the whole surprisingly well depicted in his illustrations.

With Charles Persoon the study of Mycetozoa makes a great stride, and in his work we feel to be more in touch with modern times. Persoon was born in 1755, at the Cape of Good Hope, then a Dutch colony. His father was a Dutchman, and his mother a Hottentot. His parents both died when he was a youth. With the sum of money bequeathed him by his father he came to Germany, and there devoted himself heart and soul to the pursuit of his favourite study botany, and especially to the study of

* See Nov. Gen. Pl., p. 22.

Fungi. Travelling from one university to another, he eagerly absorbed all that had been written on the subject, and made himself a name by the extent of his knowledge, and by his able writings. The series of his "*Observationes Mycologicae*" appeared in the years 1794, 1795 and 1799. His greatest work, "Synopsis Methodica Fungorum," was published in 1801 at Göttingen. But fame did not bring money. Persoon was utterly unbusinesslike, and it was as a poor man that he came to Paris in 1802. At first he was well received in scientific circles, but to quote his Italian biographer Fée, "the French could excuse all defects but one, and that Persoon possessed in a high degree. He was uncouth and grotesque in appearance." Neglected and struggling with abject poverty, he continued to carry on his work and an extensive correspondence with distinguished botanists, while he lived in a wretched garret of a tenement house in a poor quarter of the city. His landlady could not understand how her strange lodger, who seldom could pay his rent, should receive packages addressed "To the very learned and very illustrious Prince of Mycologists." It was in 1825 that Fée visited him in Paris, and found him in this miserable state. He tried to obtain assistance for him from wealthy friends, but Persoon for long rejected all offers of help, saying that it would displease him to receive aid in a manner that might cause him shame for having accepted it. Fée, however, persisted in his efforts, and Persoon was at length induced, as a Dutch subject, to part with his precious collections to the government of Holland in return for an annual pension of 800 florins. So his herbarium was packed, marked with government seals, and shipped off to Leyden. Henceforth Persoon lived in bodily comfort, but he never recovered from the humiliation of having parted with collections that represented to him so much of his life. It was as an embittered and lonely old man that he died in 1837 at the age of 82.

When my father and I visited Leyden in 1892 we called at the Reyks Museum and enquired what Mycetozoa they had in their herbarium. After being shown various modern gatherings from different parts of the world, a drawer was opened in which were exhibited a number of the actual specimens of Persoon's collection. They were kept in small open boxes without lids; but in spite of this the sporangia were in very fair preservation, and they probably show their characters as well to-day as when they were gathered more than a hundred years ago.

Persoon's "Synospsis Methodica Fungorum" is a modest little volume printed on 706 pages of thin paper, to which are added a few copper-plate engravings. The Fungi are arranged in classes, orders, genera and species, each division being defined by a few natural characters, after the manner adopted for

Flowering Plants by the great French botanist Antoin de Jessieu in his " Genera Plantarum " published in 1788.

In contrast with the work of most of his predecessors on Mycetozoa, Persoon had a wonderful aptitude for perceiving the natural relations of species and genera. In his Synopsis, although they are still included in the same Order as the Puff-balls and Mucor, they stand all together, grouped under eleven genera, all of which are retained at the present time, and which indeed form the basis of our present classification. The eighty species he describes are also for the most part retained. His descriptions give usually a good idea of the general features of the species as seen under a pocket lens. Copious references are given to the works of previous authors.

It is to be noted that of two genera only, *Lycogala* and *Fuligo*, does Persoon mention their semi-fluid condition in youth, "*interno primo pulposa* "; of *Arcyria punicea* and also of *Stemonitis fasciculata* he writes '*primo mollis.*' But besides the genera dealing with the mature state of the sporangia, he describes in another part of his book the obscure genus *Mesenterica* of Tode, in which may be recognized a description of the plasmodium stage of various species of Mycetozoa.

I may here refer to the graphic account and the illustration of creeping plasmodium given by Tode in his " Fungi of Mecklenburg," published in 1790, under the name *Mesenterica tremelloides*. Tode had, however, no idea as to the real nature of his so-called fungus. He regarded the thick margin of the plasmodium to be undoubtedly the seat of fructification: he remarks " this delicate plant disappears after twelve hours in warm air, leaving no trace behind save certain clusters of minute scales *(bracteolae)*.

Persoon in his " Synopsis Fungorum " does not suggest that *Mesenterica* may be only a stage in the life history of some other genus; but in his " Fungi Europaei," published in 1823, where he changes the name *Mesenterica* to *Phlebomorpha*, after briefly describing *Phlebomorpha rufa*, he adds " this does not appear to be the young state of a *Physarum*, which indeed consists of a very fluid amorphous mass." It is evident that he did not realize the true significance of this " *Mesenterica* " or " *Phlebomorpha*," and its connection with genera of the Mycetozoa he had described.

Of British authors who towards the end of the 18th century wrote on Fungi and described some species of Mycetozoa the two following may be noted, although they did little original work on the subject.

James Dickson, born in Peebleshire in 1738, a nurseryman and student of cryptogams, and one of the First Fellows of the Linnean Society, was the author of " *Fasciculus Plantarum*

Cryptogarum Britannicae" (1785), which contains the first description and illustration of the familiar species *Leocarpus fragilis* (Dicks.) Rost. under the name *Lycoperdon fragile*: and *James Sowerby*,* the London artist, whose drawings in "English Botany" are familiar to us; his beautiful "Coloured Figures of English Fungi and Mushrooms," published between the years 1797-1809, contain some of the best illustrations of *Mycetozoa* that had yet appeared.

At the beginning of the nineteenth century we have the Danish writer, Christian Schumacher,† publishing a "*Descriptive list of the plants of North and East Zealand*," Zealand being the island on which Copenhagen is situated. A hundred species of Mycetozoa are briefly described under the genera of Persoon's "Synopsis." There are no illustrations. Of these hundred species 72 are of Schumacher's own naming, from which we may infer either that his opportunities for consulting the works of previous authors were very limited, or that he had a strong preference for using his own name as an authority. It is rather pathetic to see how posterity has dealt with his work. Of the 72 names he gave, only two are retained at the present day. Of the rest either they refer to species that had been described before, or they are accompanied by descriptions that are too vague for identification.

One turns with relief from studying such a book as Schumacher's, to the "*Conspectus Fungorum*" of Albertini and Schweinitz.

Ludwig von Schweinitz was born in 1780 at Bethlehem, Pennsylvania, a colony of Moravian brethren founded by his maternal grandfather, the religious reformer Count von Zinzendorf. It was due to the energy and enthusiasm of Count Zinzendorf that the obscure body of men known as Moravian Brothers, the descendants of the followers of John Huss living in Moravia, was organized into one of the great missionary and educational influences of the world.

Schweinitz was devoted all his life to the interests of his community; he was also an ardent lover of botany. At the age of eighteen he accompanied his father to Germany, where he was sent to study in the theological college of Niesky in Saxony. Here one of the professors, Johannes von Albertini, a man of character with a strong taste for natural history, became his intimate friend. The outcome of their botanical studies was the publication in 1805 of "Conspectus Fungorum," or translated in full "A list of Fungi growing in the neighbourhood of Niesky in Upper Lusatia, after the method of Persoon."

* Born 1757; died 1822.
† Born 1757; died 1830.

It is an octavo volume written in Latin, with careful coloured illustrations, and containing full and graphic descriptions of the new species introduced. Seventy-three species of Mycetozoa are enumerated, as Fungi of course, of which nine are new. Six of these are still retained under the specific names given by Albertini and Schweinitz.

After an active life of travel and adventure Schweinitz returned to America, where amongst other botanical works, he published two papers on North American Fungi, entitled "*Synopsis Fungorum Carolinae Superioris*," which appeared in 1822, and "*Synopsis Fungorum in America boreali media degentium*," written in 1832. They are valuable records of the knowledge of North American Fungi and incidentally of the Mycetozoa also of that day, but the Latin descriptions are tantalizingly short and lack the informing notes that add so much to the value of Schweinitz' first book written in conjunction with Albertini.

Fortunately the herbarium made by Schweinitz is preserved in Philadelphia, and in it a certain number of his types are still to be seen. After a life devoted to his work, he died in 1834 at the age of 54.

With a brief mention only of the German botanists Link, Ditmar and Ehrenberg, of the Norwegian Sommerfelt, and of the great Swiss botanist Augustin de Candolle, all of whom described some Mycetozoa in their writings on Fungi in the first third of the 19th century, we come to by far the most eminent mycologist of his day in the person of Elias Fries.

Fries was born in 1794 at Femsjö, a village in the south of Sweden, where his father was a pastor of the Lutheran Church. Being an only child, he was encouraged from an early age to cultivate the love of nature, in order that, to use Fries' own words, "the children of Flora might be to him friends who did not desert him afterwards, but were always true." Even as a boy he was especially attracted by Fungi, and with the aid of Liljeblad's Swedish Flora, he tried to make out the names of the specimens he found in the woods, never doubting at first that all would be there described: but finding the task hopeless, he set himself to make descriptions of all the Fungi he met with, giving them temporary names; thus he learnt to distinguish between 300 and 400 species before leaving school. While working for his degree of doctor of philosophy at Lund, all his spare time was occupied with botany, which he could now study with the help of the best books of the day.

His first paper, "*Observationes Mycologicae*," part 1, was published in 1815, and from that time, almost to the year of his death in 1878, a series of valuable works continued to appear as the result of his knowledge and zeal. He not only compiled

the standard systematic works of the day on Fungi and Lichens, but published a complete Flora of the whole of Scandinavia; he also wrote on practical botany, on the nomenclature of plants, on the history of botany, and published many articles popularizing the study of plants. His scientific writings are in Latin, the language in which as a boy he had been accustomed to converse with his father. They are characterized by their vigour of style, accuracy of patient observation, and courtesy towards the work of his contemporaries and predecessors.

As to his personal character I will quote the words of his fellow countryman, Lundström, to whose memoir of Fries I am indebted for these notes on his life.* "His lively interest in his science, and his affectionate regard for all who pursued it, procured him the veneration and love of all; and those who participated in a more confidential intercourse with him, cannot praise their good fortune enough in having had the happiness of the acquaintance of a man so noble and so good as Fries." He died in 1878, at the age of 84.

The account of the Mycetozoa given by Fries in the third part of "*Systema Mycologicum*," published in 1829, was by far the best work on the subject that had yet been written, and is still a treasure-house of interesting observation and historical information.

For the first time this group, though still included in the Order *Gasteromycetes*, is separated from the Puff-balls, and given a suborder to itself, the *Myxogastres*, which is characterized by being in a young state "mucilaginous and flowing," instead of hard and fleshy. So impressed was Fries with the importance of the different aspects of the "mucilaginous state" as he called the plasmodium, whether it was seen emerging from wood to form sporangia in a cushion-like mass, or whether it crept over the surface in a network of veins, that he distinguishes four different appearances of the plasmodium by name; viz., the "*Lycogala* state," where the plasmodium emerges to form a compact mass resembling the mature fructification,—as in *Lycogala;* the "*Mucilago* state," where the plasmodium and fructification alike appear as an irregular mass, as in *Fuligo;* the "*Mesenterica* state," where the plasmodium consists of a superficial network of veins from which the sporangia are at length formed by concentration at many points, as in *Diachaea;* and the "*Embolus* state," where the plasmodium emerges in a cushion-like mass and then divides into many separate sporangia, as in *Stemonitis.*

Fries gives a graphic account of how his attention was first drawn to the swiftness of growth of the "*Mesenterica*" stage,

* See Journ. Bot. xvii. (N.S. viii.), p. 33.

from his having by chance placed some of the young "*Mesenterica*" of *Diachaea* in his cap, and how he was moved to admiration by finding that in the space of one hour much of it had spread out there to form an elegant white network.

The classification of species he adopts is essentially that of Persoon, whom he refers to as most reliable, "*probatissimus*," but it is modified to include six new genera. The descriptions of both genera and species, with the ample explanatory and historical notes accompanying them, and the full synonymy, are all admirably prepared. Minute details that could only be seen with the microscope he does not refer to. Thus characters which we regard as obvious nowadays, such as the presence or absence of calcareous deposits about the sporangium-wall, or the peculiar markings on the capillitium threads, were apparently unrecognized by Fries, although the spiral markings of the elaters of *Trichia* had been described and figured by R. A. Hedwig as early as 1802.*

Although Fries belonged to the older school of botanists who believed in the immutability of species, he yet possessed an instinct which enabled him to arrange these species with a wonderful appreciation of their natural affinity. Sachs, in his "History of Botany," refers to there being, in Fries' opinion, "something supernatural," as he expressed it, in this natural affinity of organisms, which makes a natural system possible. He considered that each division of such a natural system, each genus, might be regarded as expressing an *idea*, and these ideas together might be explained as representing the original plan of Creation.

But still the difficulty remained, and continued to remain in the minds of all thinking men, until Darwin's theory of descent gave the clue to natural affinity, and the doctrine of immutability of species could be dismissed for ever.

A contemporary and disciple of Fries was our countryman the Rev. Miles Berkeley. Berkeley was born at Oundle, Northamptonshire, in 1803, and was therefore only nine years younger than Fries. Educated at Rugby and Christ's College, Cambridge, he took holy orders and settled as a curate at Margate. Here, besides his professional duties, he seems to have occupied himself with natural history generally. His first publications were on Mollusca and Algae, but he must have acquired also a considerable knowledge of Fungi for him to have received a proposal from Sir William Hooker that he should write the section on Agarics for the volume on Fungi in "Smith's

* See Observationum Botanicorum, fasc. primus, Tab. x., xi. C. C. Schmiedel had also figured spirals on the elaters of a species of Trichia, but the value of his observation is impaired by his having drawn spiral markings on threads forming the net of the sporangium of what is clearly *Cribraria purpurea* Schrad. See Schmiedel, Ic. Plant. (1762-1776) Pl. xxiv., xxiii.

English Flora," of which Hooker was editor. Later, Berkeley undertook to complete the whole volume, when Hooker writes: "I have now to express my cordial acknowledgments, in which I am satisfied I shall be joined by every botanist in the country, to the Rev. M. J. Berkeley for having undertaken to prepare the whole of this vast family for the press, and it is certain the task could not have fallen into better hands."

This book, published in 1836, at once took its place as the standard work on British Fungi. The classification, and definitions of genera and species are those of the "*Systema Mycologicum*" of Fries. The notes on the species are Berkeley's own. They bring together an immense amount of information collected by others, and abound in original and critical observations. Of the "Myxogastres," 63 species are recorded for Britain, four of which are described as new, but these four are not now considered worthy of specific rank. He warmly expresses gratitude for the help given him by "that assiduous and faithful observer," Thomas Purton, author of "the Midland Flora," whose valuable notes were placed at Berkeley's service; also for the assistance he received from Dr. Robert Kaye Greville of Edinburgh, author of a beautifully illustrated "Scottish Cryptogamic Flora," published between the years 1823 and 1829, a work that unfortunately came to an untimely end for want of funds.

From this time Berkeley was an enthusiastic investigator of Fungi, and in spite of the many difficulties he had to contend with he continued to pursue the study with unwearied interest to the end of his life. After leaving Margate in 1833 he became rector of Kingscliffe, Northamptonshire; later, in 1868, he became vicar of Sibbertoft in Leicestershire, where he remained till his death. He married, and had a large family. For some years, to increase a modest income, he kept a school for boys. He was at this time the first authority in the country on plant diseases and Fungi. Specimens from all parts, from home and abroad, poured in for his critical examination, and the only leisure he could obtain in which to study and write on them was found by rising very early in the morning before school hours,—a severe tax on one whose health was often far from strong.

Berkeley's work on Mycetozoa appears chiefly in his papers on the Fungi that were sent him by collectors from abroad, and consists of lists of the species found, and descriptions of new species. Such papers are those "On the Fungi of North America," "On the Fungi of Cuba," and "On the Fungi of Ceylon" written in conjunction with his friend and fellow-worker Christopher Broome. The types of these species are preserved to us partly in Berkeley's herbarium at Kew, partly

in the British Museum in the collection of Broome, with whom he shared many specimens.

In reading Berkeley's descriptions of Mycetozoa, one is struck, even in his later papers, with how little use he seems to have made of modern microscopical appliances. He presents us with an excellent idea of the object before him as seen under a good pocket lens, but as regards details of structure his observations show little advance on those made by Fries thirty or forty years before. In some cases, however, spore measurements are given that are fairly correct. He made a curious mistake in thinking that the clusters of spores in the sporangia of his new genus *Badhamia* were enclosed in a hyaline sac that afterwards bursts or is absorbed. This was an idea he firmly adhered to. It was quoted by him as an argument in favour of the Myxogastres being true Fungi, rather than allied to animals, a view that had been recently brought forward by de Bary, as the result of his investigation into their life history. Berkeley writes as follows on the subject, in 1860, in Outlines of British Fungology:—"A large group of Fungi, containing multitudes of the most exquisite microscopic objects, is distinguished by the early conditions being creamy or mucilaginous. They differ in many respects from other Fungi, and especially because they seem often quite independent of the substance on which they are developed. . . In consequence of this, and of some other peculiarities in the substance of which they are formed resembling that of which certain *Infusoria* are composed, a very excellent observer, Dr. de Bary has lately expressed the formal opinion that they are animals, but a sufficient answer to this is the fact that some species have spiral vessels" (he alludes of course to the elaters of *Trichia*), "and have their spores surrounded by a distinct sac." On a further page he adds cautiously:—"Though, however, I have myself little doubt as to these productions being vegetables as well as other Fungi, and I am supported in this view by Fries, than whom no one is more eminent for tact and nice discrimination, it is right that I should not speak too positively, as the two brothers Tulasne, who have added so much to our knowledge of Fungi, incline rather, as it should seem, to de Bary's views, which they corroborate in some degree by the fact that many of these productions contain in their outer coat a notable quantity of carbonate of lime";—a curious argument to support the animal affinities of the Mycetozoa!

These quotations are given to show the views held by Berkeley with regard to the position of the Mycetozoa; but it must not be supposed he was indifferent to the great discoveries that were being made by the investigations of the new school of Continental, and especially of German botanists, into the life-

history of Fungi and Cryptogams generally. On the contrary he followed them with intense interest, and was only scornful of those British writers whose ignorance led them to make light of what they did not understand.

Considering the comparatively secluded life led by Berkeley, it seems astonishing how much good scientific work he managed to accomplish in his country parsonage. Besides contributing largely to our knowledge of Fungi, he was the first to make the study of Fungi in any way popular in this country. This he did by such works as "Introduction to Cryptogamic Botany," "Outlines of British Fungology," and by many popular articles; also by the genial encouragement he gave to all who applied to him for advice.

Berkeley died in 1889 at the age of 86.

We now pass to the work of the great master whose patient research and wide grasp of general principles enabled him to shed light on every subject he investigated. With Anton de Bary we feel that the study of Mycology is lifted to a higher plane.

Germany had at this time produced a brilliant circle of botanists, whose theories and discoveries were making a new epoch in the botanical world. Freed from the older traditions in which description and classification took too prominent a place, they attempted by minute investigation and reasoning to discover the principles of the development and life of plants. Nägeli, Hugo von Mohl, and Hofmeister were living, and profoundly influencing the thought of the time by their observations on histology and embryology.

De Bary was born at Frankfurt in 1831. He was the son of a medical practitioner, and himself entered the medical profession. Admiration of Von Mohl, then professor of botany at Tübingen, induced him to give up practice and come to Tübingen, where he took the position of Lecturer on Botany in the University. In later years he became professor of botany, first at Freiburg, then at Halle, and finally at Strassburg, where he remained until his death in 1888. The work that de Bary accomplished during his comparatively short life is amazing. Besides his investigations into the morphology, physiology and development of Fungi and Lichens, his studies extended to the higher Cryptogams and to Flowering plants. The late Prof. Marshall Ward, who worked under de Bary at Strassburg, writes of his enormous influence on the progress of Biology, of his unflinching honesty, rigorous self-criticism and modesty, of his marvellous grasp of detail and power of logical generalization, also of the keen appreciation he had for all good work. By his personal influence he attracted a band of enthusiastic students, very many of whom have since become eminent in science.

It is to de Bary that we owe the modern view of the position of the "Mycetozoa," or "Fungus-animals," as we may translate the name he gave to the group which consists for the most part of the "Myxogastres" of Fries. In his article entitled "Die Mycetozoa," published in 1859, of which a second edition appeared in 1864, he gives an account of his observations.

It was de Bary who first cultivated the spores and saw them give birth to nucleated "*swarm-cells*"; he watched the swarm-cells dividing in hosts in the field of the microscope; saw them withdraw their flagella and creep about as myxamoebæ. He inferred that it was by the union of such myxamoebæ that the young plasmodia abounding in his cultures were formed, but it was the Russian botanist Cienkowski, working contemporaneously, who first saw the actual union of myxamoebæ take place, and who gave the name "*plasmodium*" to those masses of naked protoplasm which Fries had called "*mesenterica*"; Cienkowski was also the first to notice the ingestion of solid food by the plasmodium, an observation that showed the animal affinities of these organisms. De Bary first described the structure of the plasmodium, and its remarkable rhythmic circulation; he also showed how the sporangia of all Mycetozoa arise from such plasmodia. He first described in detail the formation of the young sporangia, of the capillitium and of the spores. Summing up the observations of earlier authors, he described the minute structure of the different types of mature sporangia in a way that had never been done before. To the nuclear history of the Mycetozoa de Bary refers in a later book, "The Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria," published in 1884. Here he mentions the work of Strasburger, who had recently established the presence of numerous nuclei in the plasmodium, which presumably were the persistent nuclei of the swarm-cells and the products of their division; Strasburger had also observed the division of these nuclei by mitosis in the young sporangium prior to spore-formation.

With the further nuclear changes that occur in the plasmodium and swarm-cells, de Bary was not acquainted, and indeed this subject still presents problems that have not been solved with certainty.

De Bary's pupils carried on his methods in the spirit of their master. A number of them took up the study of Mycetozoa, prominent amongst whom were the Russian botanist Woronin, who with his friend Famintzin worked out the chief features in the life history of *Ceratiomyxa*, and the eminent Pole, Dr. Joseph Rostafinski, whose splendid "Monograph of Mycetozoa," compiled under de Bary's guidance, and beautifully illustrated, was published in 1875. This work became at once the standard

authority on the subject. But in spite of its great merits the full value of the book is hidden from most of us, for it is written in the Polish language. To a certain extent the main features are given in an English translation of the keys to the genera and species, with abstracts of the characters defining the British species, published by M. C. Cooke. In Saccardo's "Sylloge Fungorum," vol. VII., abstracts in Latin of the descriptions of Rostafinski's species also appear, but the elaborate critical and historical notes of the original volume have I think never been translated from the Polish.

Dr. Rostafinski is still alive, but it is to be feared that he must be reckoned among the past students of Mycetozoa, for he no longer works at the subject, and has embarked on the troubled waters of Polish politics. With his work we come practically to our own times, and here I bring this short account to a close.

I am aware that there are many others who have now passed away whom I have not mentioned, whose published writings and friendly correspondence gave invaluable assistance to my father when he was collecting materials for compiling "the British Museum Catalogue of Mycetozoa"; such were Prof. Axel Blytt, of Christiana, Dr. George Rex, the genial physician of Philadelphia, Mr. A. P. Morgan, of Ohio; but in this sketch it is the historical aspect of the subject that I wished to keep in view, and I have therefore aimed at referring chiefly to those in the past whose work has made landmarks in our knowledge of Mycetozoa.

SUR DEUX NOUVELLES ESPÈCES DE DISCOMYCÈTES D'ANGLETERRE.

Par Mr. Em. Boudier.

Pl. 2.

I. *Ascobolus Carletoni* Boud.

Minutissimus, $0^{mm.}$, 50 ad 1 mm. latus, omnino albus, sessilis sed parte infossa turbinatus, dimidiá parte supera glaber, non marginatus, inferne furfuraceus. Paraphyses simplices aut divisae, ad apices irregulariter incrassatae, hyalinae. Thecae clavatae, octosporae, 160 ad 210μ longae, 18-20 crassae. Sporae ellipticae, primo hyalinae, dein violaceae, laeves, 15-16μ longae, denique episporio diffracto verruculosae et tunc pallidiores, crassiores, 16-20μ longae, 10-11 latae.

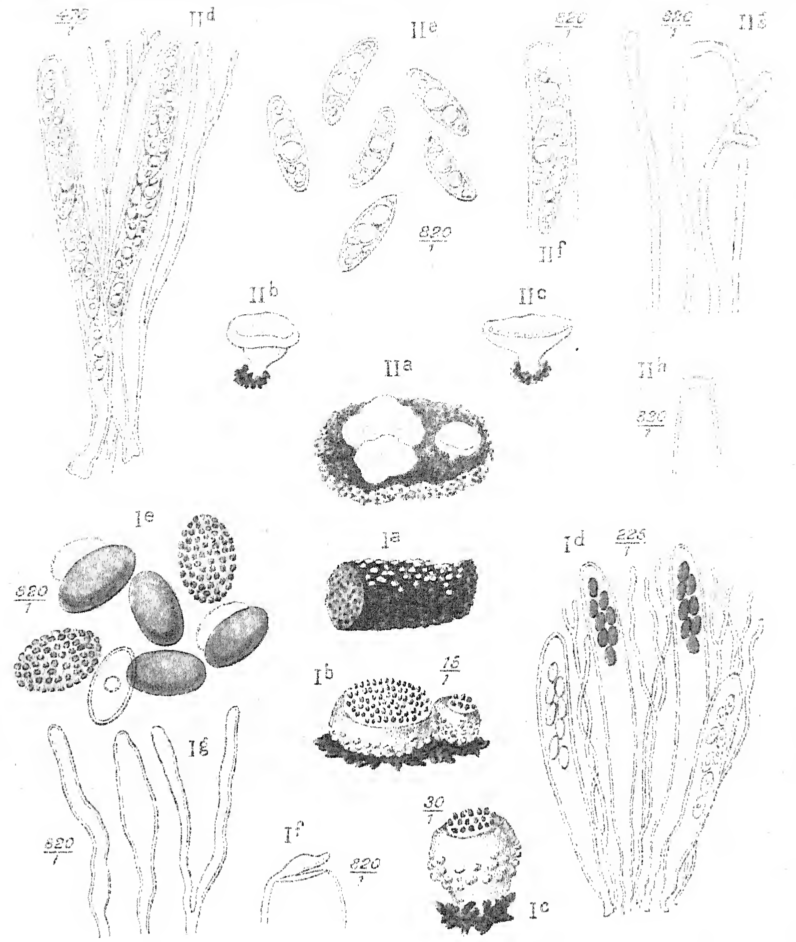
Ad stercus Tetraonis urogalli. In Scotia Octobre, 1912. Misit amicus Carleton Rea cui gratissime dicavi.

Cette jolie petite espèce me parait bien différer des espèces blanches connues, par sa petitesse, ses réceptacles immarginés, glabres supérieurement mais visiblement furfuracés dans leur moitié inférieure, à hymenium non coloré, et par ses spores. Ces dernières au nombre de huit dans chaque thèque, ne mûrissent pas toujours en même temps et on rencontre assez souvent de ces dernières qui en présentent un certain nombre d' incolores.

II. *Calycella Menziesi* Boud.

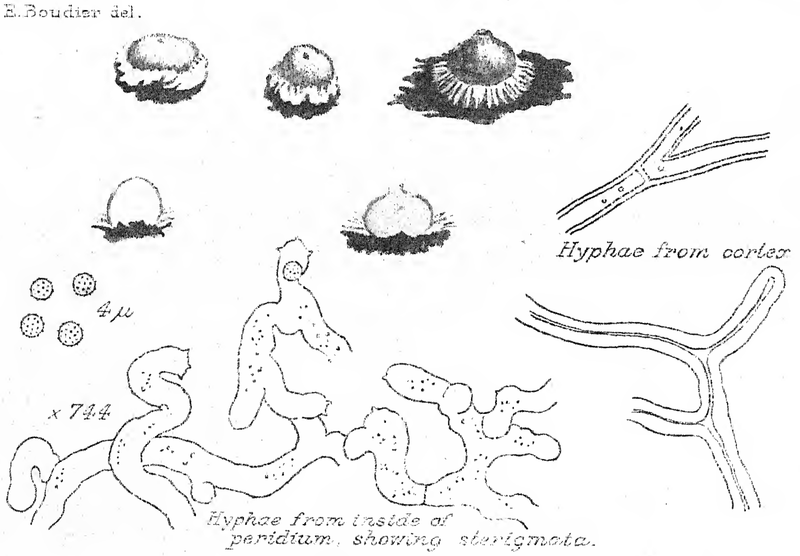
Pro genere major, 5-12 mm. lata, turbinata aut crasse et breviter stipitata, pallide rosea aut salmonicolor. Receptacula cupulata, carnosa, glabra, margine integro aut sublobato, extus pallidiora, carne alba. Paraphyses tenues, simplices aut divisae, rarius superne ramosae, sub lente hyalinae, ad apices non aut vix incrassatae, 2-3μ spissae. Thecae cylindrico-clavatae, 8-sporae, inoperculatae, foramine marginato, 100-110μ longae, 8-9 latae. Sporae oblongo-fusiformes, albae, continuae, intus guttulosae, guttulis saepius 3 majoribus granulis minoribus comitantibus donatae, saepe leniter curvatae, 15-17μ longae, 4-5 crassae.

Ad terram argillosam in Perth, Scotiae, Septembre, 1912, misit clarissimo Menzies, cui amice dicavi.



I. Ascobolus Carletoni *Boud.* II. Calycella Menziesi *Boud.*

E. Boudier del.



Capillitium *5-10 μ. diam.*

E. A. Rea & G. Lister del. West, Newman chr.

Glischroderma cinctum *(Fckl.)*

Cette espèce remarquable par sa taille, sa couleur et sa station franchement terrestre, a tout-à-fait l'aspect exterieur d'un *Geopyxis* mais s'en distingue de suite nettement par ses thèques inoperculées et ses spores fusoides et guttulées. Sa grande taille et sa station terrestre la fent s'éloigner à première vue des *Calycella* auxquels j'ai cru cependant devoir là réunir par ses thèques inoperculeés, à foramen marginé et des spores.

Explication de la Planche 2.

I. *Ascobolus Carletoni* Boud.

a. Crotte de Tetras garnie d' Ascoboles, grandeur naturelle.
b. Groupe de deux réceptacles jeune et adulte, grossi 15 fois.
c. Autre réceptacle isolé jeune et montrant sa forme turbinée, grossi 30 fois.
d. Groupe de thèques et de paraphyses grossi 225 fois.
e. Spores à divers âges grossies 820 fois.
f. Extrémité supérieure d'une thèque vide montrant son opercule au même grossissement.
g. Extrémités supérieures de diverses paraphyses montrant leur variation, grossies 820 fois.

II. *Calycella Menziesi* Boud.

a. Groupe de 3 exemplaires à divers âges représentés grandeur naturelle.
b. Autre spécimen isolé.
c. Coupe d' un autre de même grandeur nature.
d. Groupe de thèques et de paraphyses grossies 475 fois.
e. Spores vues à un grossissement de 820 diamètres.
f. Extrémité supérieure d' une thèque garnie de ses spores vue au même grossissement.
g. Extrémités de diverses paraphyses grossies de même.
h. Extrémité d' une thèque vide montrant son foramen marginé, grossie 820 fois.

GLISCHRODERMA CINCTUM FCKL.

By Carleton Rea, B.C.L., M.A., &c.

WITH PLATE 2.

Between the years 1869 and 1875 Fuckel published his Symbolae Mycologicae, and at page 34 thereof he gives the following definition of this genus and species. " GLISCHRODERMA Peridium hemisphaericum, tenax, persistens, demum in centro irregulariter fissum, e floccis tenuissimis contextum, furfuraceo-villosum; basi mycelio tenuissimo cinctum, sporidiis coacervatis, minutissimis, globosis, floccis destitutis repletum. Obs. Peridium in statu juvenili siccum, album, contextu fibroso, dein in centro ampliatum, argillaceum, annulo albo e peridio juvenili represso orto circumdatum. *Glischroderma cinctum* Fckl. Fung. Rhen. 162. Peridio hemisphaerico usque ad semiunciam diametro transversali, argillaceo, cum annulo albo, fibroso cincto, ore destituto sed demum irregulariter in centro fisso; sporidiis globosis, uniguttulatis, ca. 4 mik. diam., argillaceo-rubellis. Tab. I. Fig. 18. a, Fung. nat. magn. b, sporid. Auf verlassenen Köhlerstellen an Kohlenstückchen, sehr selten, im Herbst. Unweit der Arnsbacher Brücke, im Winkler Wald." My attention was first drawn to this species by our fellow member Mr. W. B. Allen, at a meeting of the Worcestershire Naturalists' Club held in Wyre Forest on the 16th of September, 1909. We found a few specimens growing on a charcoal heap situate a short distance from the Inn at Button Oak, in Shropshire. At first sight this species looks exactly like *Lycogala epidendrum* seated on a circular mass of white mycelium. The material gathered on that occasion was insufficient to determine its systematic position and after many fruitless visits to the same charcoal heap a few more ripe specimens were obtained on the 9th of October, 1910, which did not further their identification. On the 18th of October, 1912, I found a good number of specimens on two fairly recent charcoal heaps in another portion of Wyre Forest adjacent to the Duke William Inn on the Cleobury road, Worcestershire. After a very careful examination of these specimens I came to the conclusion that they should be referred to this species and my determination was subsequently confirmed by Monsieur Emile Boudier and L'Abbé G. Bresadola. The definition of the genus, however, requires emending in the following points, the

peridium is only moderately tough and durable and it dehisces by a well defined central pore that gradually enlarges. There is a well developed capillitium attached to the inner walls of the peridium. The following is a full description of the British specimens of *Glischroderma cinctum* (Fckl.). Peridium hemispherical, 5-15 mm. across, at first pale grey and slightly sticky, becoming darker with age and slightly scurfy, dehiscing by a well defined central pore which becomes larger, and seated on a ring-like mass of white mycelium ·5-2 mm. wide at the base. Capillitium attached to the inner wall of the peridium, hyaline, septate, 5-10μ wide, thick walled. Spores pale pink, round, 4μ, minutely warted, showing 4 to 5 warts in a row across the hemisphere. This Gasteromycete is assigned doubtfully by E. Fischer in Engler and Prantl's Natürliche Pflanzen-familien I. teil, 1 abteilung, 313 to the *Hymenogastrineae*, but L'Abbé G. Bresadola (in litt.) considers that it belongs to the *Plectobasidiineae* and constitutes the type of a family that should be placed near to the *Tulostomataceae.*

NOTES ON THE FUNGUS-FLORA OF THE MORAY DISTRICT.

By D. A. Boyd.

In view of the Society's visit to Forres, some attention may appropriately be devoted to the ascertained fungus-flora of the Moray district, in which that town is situated. In accordance with the division of Scotland into provincial areas based upon the principal water-sheds, river basins, and estuaries, the district of "Moray" has been understood to include the whole of the extensive region which drains into the Moray Firth between Ord of Caithness and Fraserburgh.* As very little is known regarding the mycology of the portion of that district north of the Ness basin, it may be convenient for us to confine our attention to the portion south of the Caledonian Canal, and, in particular, to the valleys of the Rivers Spey and Findhorn, and the country adjacent to the town of Forres. While this region has long been famed for beauty of scenery and geniality of climate, it has also been brought prominently into notice as a remarkably fertile field for botanical research, mainly through the successful labours of the late Rev. James Keith, LL.D., who for many years was minister of the parish of Forres. Having been attracted to the study of mycology, Dr. Keith entered into correspondence with Berkeley, Cooke, Currey, Phillips, Plowright, and other recognised English authorities, from whom he received encouragement to persevere in the work of investigating the Fungi of North-eastern Scotland, which up till that time had been almost wholly neglected. For a long period he continued to submit for identification specimens obtained in the richly-wooded district around Forres, and in the more distant pine-forests of Grantown, Rothiemurchus, &c. Many of these specimens were found to represent species unrecorded for Britain, or unknown to science, and as such were described by Messrs. Berkeley and Broome in the long series of notices of new or rare Fungi, communicated by them to the "Annals and Magazine of Natural History."

* This system of division was first proposed by Dr. Buchanan White in the "Scottish Naturalist," vol. I., p. 161. It was adopted by the Rev. Dr. Stevenson as the basis of his "Mycologia Scotica" (1879), and by Professor Trail and others in their lists of Scottish fungi, etc. It has also been followed, in a modified form, by Messrs. Harvie-Brown and Bartholomew in their "Naturalists' Map of Scotland."

In 1874, Keith contributed to the "Scottish Naturalist" a "List of Fungi found within the Province of Moray, chiefly in the vicinity of Forres." This was followed in 1878-79 by a "Supplementary List," and in 1884 by a "Second Supplementary List."* The Fungi enumerated in these three lists reach a total of 1,297 species, 574 of which are Hymenomycetes and 437 Ascomycetes. Since 1884, a considerable number of new records for the Moray district, including some notable additions to the British fungus-flora, were reported from time to time by Cooke, Phillips, and Plowright, in "Grevillea," as well as in the respective works on mycology published by these authors. These additions were nearly all due to Dr. Keith's researches. Many of them are attested by type-specimens preserved in the herbaria in the British Museum and at Kew, and some have not as yet occurred elsewhere in Britain. Looking at the list of Moray Fungi as a whole, it is remarkable for the large proportion of rare or uncommon species enumerated, and in that respect affords evidence of a fertility which probably can scarcely be surpassed in any other locality in our country.

Many interesting discoveries have been made in the neighbourhood of Aviemore, Invernesshire. This portion of the Spey valley lies directly opposite the main group of mountains of the Cairngorm range, of which a very impressive view is obtainable from the village. In the vicinity is the ancient forest of Rothiemurchus, which extends for some miles along the valley between the mountains and the river, and is intersected by numerous minor streams. During recent years, many of the oldest trees on the border of the forest have been cut down. Throughout the district there are numerous sawmills where the timber used for purposes of the estate is cut into suitable portions; and on the accumulated heaps of pine sawdust various rare species of Fungi have sometimes occurred. Among these may be mentioned *Pluteus cervinus* (Schaeff.) Fr., var. *petasatus* Fr., *P. nanus* (Pers.) Fr., *Flammula spumosa* Fr., *Paxillus panuoides* Fr., and *Boletus sulphureus* Fr.

In the immediate vicinity of Aviemore, and in the neighbouring woods at Alvie and Kinrara, many notable species have from time to time been discovered. As illustrative of these, reference may be made to *Omphalia grisea* Fr., *O. campanella* (Batsch) Fr. var. *badipus* Fr., *Pleurotus tremulus* (Schaeff.) Fr., *Entoloma griseocyaneum* Fr., *Leptonia asprella* Fr., *Nolanea rufocarnea* Berk., *Naucoria erinacea* Fr., *Cortinarius (Inoloma) bolaris* Fr., *Hygrophorus nitratus* (Pers.) Fr., *Polyporus melanopus* Fr., *Polystictus polymorphus* Rostk., *Clavaria amethystina*

* Scottish Naturalist, Vol. II., pp. 210, 243, 305, 363; Vol. IV., p. 342; Vol. V., pp. 8, 93; Vol. I. (New Series), pp. 224, 270.

(Bull.) Fr., *Ulocolla saccharina* Bref., *Scutularia littoralis* (Phil. & Plow.) Sacc., *Pseudopeziza foecunda* (Phil.) Sacc., *Zignoella collabens* (Curr.) Sacc., *Thyridium lividum* (Pers.) Sacc., *Hypocopra fimicola* (Rob.) Ces. & de Not., *Sordaria coprophila* (Fr.) Ces. & de Not., *S. platyspora* (Plow.) Sacc., *Delitschia Winteri* Plow., *D. minuta* Fckl., *Sporormia minima* Awd., *S. megalospora* Awd., *S. octomera* Awd., *S. pulchra* Hans., *Lophiostoma arundinis* (Fr.) Ces. & de Not., *L. macrostomum* (Tode) Ces. & de Not., *Stagonospora vexata* Sacc., *Stilbum orbiculare* B. & Br., and *Graphium griseum* (Berk.) Sacc.

Loch-an-Eilean, a lovely little lake with an imposing background of mountain and forest, is justly esteemed one of the beauty-spots in the Aviemore district. Among the Fungi noted for the neighbourhood of the loch are *Volvaria speciosa* Fr. and *Pluteus umbrosus* (Pers.) Fr. In the little island with ruined castle, long visited for nesting purposes by a pair of ospreys, *Flammula alnicola* Fr. var. *salicicola* Fr. has occurred on decaying willow.

From a mycologist's point of view, however, the main interest of the district is centred in Rothiemurchus forest itself, with its wealth of fungus life. Here, as in the other old pine-woods of the Moray region, one is impressed by the unusual size and abundance of the larger species of Tricholoma. Boleti in considerable variety are also remarkably plentiful. Perhaps the most interesting Fungi of the forest, however, are the various large species of Hydnum, which may be said to have their home in the pine-woods of Scotland, and are rarely if ever obtainable in the south. Where the ground is carpeted with the red whortleberry (*Vaccinium Vitis-Idaea*), the leaves of that shrub frequently display the pale gall-like swellings produced by *Exobasidium vaccinii* Woronin; and where the carpet consists of *Linnaea borealis*, the leaves are often conspicuously spotted by *Venturia Dickiei* (B. & Br.) Ces. & de Not.

The Fungi recorded for Rothiemurchus include a large proportion of uncommon species, of which only a few can be mentioned. Reference may be made to *Armillaria bulbigera* (A. & S.) Fr., *A. robusta* (A. & S.) Fr., *Tricholoma pessundatum* Fr., *Pleurotus acerosus* Fr., *Entoloma Bloxami* B. & Br., *Clitopilus undatus* Fr., *Nolanea mammosa* (Linn.) Fr., *Inocybe asterospora* Quél., *Hebeloma punctatum* Fr., *H. versipelle* Fr., *Flammula scamba* Fr., *F. spumosa* Fr., *F. astragalina* Fr., *F. hybrida* Fr., *F. inopoda* Fr., *Stropharia Jerdoni* B. & Br., *Psilocybe bullacea* (Bull.) Fr., *Coprinus Hendersoni* Berk., *Cortinarius (Phlegmacium) claricolor* Fr., *C. (Ph.) turmalis* Fr., *C. (Myxacium) stillatitius* Fr., *C. (Inoloma) traganus* Fr., *C. (I.) tophaceus* Fr., *C. (Dermocybe) cinnabarinus* Fr., *Lactarius hysginus* Fr., *L. flexuosus* Fr., *L. helvus* Fr., *L. picinus* Fr., *Poly-*

porus leucomelas Fr., *Merulius tremellosus* (Schrad.) Fr., *M. molluscus* Fr., *Hydnum imbricatum* (Linn.) Fr., *H. scabrosum* Fr., *H. compactum* (Pers.) Fr., *H. ferrugineum* Fr., *H. scrobiculatum* Fr., *H. zonatum* (Batsch) Fr., *H. nigrum* Fr., *H. cyathiforme* (Schaeff.) Fr., *Corticium salicinum* Fr., *Clavaria purpurea* Fr., *Rhizopogon rubescens* Tul., *Helvella infula* (Schaeff.) Fr., *Helotium nudum* (Phil.) Mass., *Lachnea hirtococcinea* (Phil. & Plow.) Phil., *Perisporium vulgare* Corda, *Capnodium juniperi* Phil. & Plow., *Hypomyces violaceus* (Fr.) Tul., *Xylaria pedunculata* Fr., *Melanomma obliterans* (B. & Br.) Sacc., *Trichosphaeria superficialis* (Curr.) Sacc., and *Stilbum orbiculare* B. & Br.*

In the course of the short journey of thirteen miles from Aviemore to Grantown, the road passes from the county of Inverness into that of Elgin. The town of Grantown-on-Spey is of modern origin, and dates from 1766. It has not only rapidly increased in size, but has steadily grown in popularity as the centre of a delightful district, and has also attained considerable repute as a health resort, by reason of its high situation (731 feet above sea-level) and invigorating air. In the Grant country, the extensive pine woods form a striking feature in the landscape, and owe their existence to the prudent policy of successive proprietors in largely increasing the area planted with timber.†

As might be expected from the nature of the ground, the district around Grantown has proved very rich in Fungi. Among the species recorded for this locality are *Amanita virosa* Fr., *Armillaria robusta* (A. & S.) Fr., *Tricholoma pessundatum* Fr., *Flammula spumosa* Fr., *F. inopoda* Fr., *Naucoria tenax* Fr., *Corticium (Phlegmacium) claricolor* Fr., *C. (Myxacium) mucifluus* Fr., *C. (M.) delibutus* Fr., *C. (M.) stillatitius* Fr., *C. (Inoloma) traganus* Fr., *C. (Hygrocybe) leucopus* (Pers.) Fr., *C. (H.) decipiens* (Pers.) Fr., *Lactarius hysginus* Fr., *L. helvus* Fr., *Cantharellus umbonatus* Fr., *Boletus cyanescens* (Bull.) Fr.,

* A wise precaution for solitary visitors to Rothiemurchus is to provide themselves with a good map and pocket compass. Nothing is easier than to lose one's bearings in such a wilderness where all familiar landmarks are hidden from view. Stories are told of the discomforts of unfortunate wanderers who failed to extricate themselves from the leafy maze before the shades of evening had fallen.

† It is stated that by the year 1847, Sir Francis William Grant (afterwards sixth Earl of Seafield) had planted on his residential estates of Cullen House (Banffshire), Castle Grant (Strathspey), and Balmacaan (Glen Urquhart), no fewer than 31,686,482 young trees, for which enterprise he was awarded the gold medal of the Highland and Agricultural Society. This policy was continued by his successor; and it has been estimated that the number of trees planted on the Seafield estates during the last sixty or seventy years cannot be far short of two hundred millions. The three principal forests on the Speyside estate are situated at Duthil, Grantown, and Abernethy.

Hydnum fragile Fr., *Coniophora byssoidea* (Pers.) Karst., *Phacidium phacidioides* (Fr.) Mass., *Crumenula urceoliformis* Karst., *Saccobolus neglectus* Boud., *Pseudopeziza foecunda* (Phil.) Sacc., *Mollisia juncina* (Pers.) Rehm, *M. arundinacea* (DC.) Phil., *Belonidium excelsius* (Karst.) Phil., *Humaria cervaria* (Phil.) Sacc., *H. bovina* (Phil.) Sacc., *Melanospora chionea* (Fr.) Corda, *Anthostomella tomicum* (Lév.) Sacc., *Coprolepa merdaria* (Fr.) Fckl., and *Ramularia Keithii* Mass.

In passing from the valley of the Spey to that of the Findhorn, a tract of dreary moorland is crossed, but as the Findhorn is approached, a very fertile district is again entered upon. For several miles the river flows through a deep V-shaped rocky ravine, amid scenes of remarkable grandeur and beauty, which may be said to culminate in the neighbourhood of Dunphail. The wooded country around Dunphail is also notable for its mycological records. These include *Amanita excelsa* Fr., *A. virosa* Fr., *Collybia ambusta* Fr., *Mycena adonis* (Bull.) Fr., *Pleurotus atrocaeruleus* Fr., *Inocybe fibrosa* (Sow.) Fr., *Cortinarius (Inoloma) callisteus* Fr., *Marasmius saccharinus* (Batsch) Fr., *Panus patellaris* Fr., *Trogia crispa* Fr., *Polyporus Keithii* B. & Br., *Poria nitida* (Pers.) Fr., *Merulius rufus* (Pers.) Fr., *Porothelium Keithii* B. & Br., *Radulum deglubens* B. & Br., *Corticium polygonium* Fr., *Clavaria tuberosa* (Sow.) Fr., *Keithia tetraspora* (Phil. & Keith) *Sacc.*, *Phacidium minutissimum* Awd., *Patellaria connivens* Fr., *Pseudopeziza palustris* (Rob.) Mass., *Mollisiella ilicincola* (B. & Br.) Mass., *Helotium bolare* (Batsch) Mass., *Hypocrea fungicola* Karst., *Pleospora nigerrima* (Blox.) Sacc., *Anthostoma melanotes* (B. & Br.) Sacc., *Leptosphaeria praetermissa* (Karst.) Sacc., *Helicosporium Mulleri* Sacc., *Triposporium elegans* Corda, &c.

Between Dunphail and Forres, the Findhorn passes for some miles through a richly wooded country. Stretching away to the left is the extensive estate of Darnaway Castle (Earl of Moray), surrounded by a forest which contains a large proportion of oak trees. On the right is the finely wooded estate of Altyre, the property of Sir W. G. Gordon-Cumming, Bart. From the lists of species observed here from time to time, it may be inferred that the prevailing conditions are more than usually favourable to fungus life.

In the Darnaway woods have been found *Polyporus lacteus* Fr., *Poria nitida* (Pers.) Fr., *P. reticulata* Fr., *Merulius rufus* (Pers.) Fr., *Hydnum udum* Fr., *Phlebia radiata* Fr., *Patellaria lonicerae* Phil., *Cenangium pulveraceum* (A. & S.) Fr., *Humaria Oocardii* (Kalchbr.) Sacc., *Hypocrea fungicola* Karst., *Chaetosphaeria phaeostroma* Dur. & Mont., *Leptosphaeria rhacodium* (Pers.) Ces. & de Not., *L. canescens* (Pers.) Sacc., *Pleospora nigerrima* (Blox.) Sacc., &c.

At Sluie, on the Altyre side of the river, *Marasmius Hudsoni* (Pers.) Fr., *Morchella conica* Pers., and *Venturia ilicifolia* Cke., have been found; while the Altyre Woods themselves have yielded many interesting species, including *Lepiota clypeolaria* (Bull.) Fr., *Tricholoma ustale* Fr., *T. murinaceum* (Bull.) Fr., *T. lascivum* Fr., *Collybia plexipes* Fr., *C. inolens* Fr., *Mycena strobilina* (Pers.) Fr., *M. pterigena* Fr., *M. peltata* Fr., *M. vitrea* Fr., *Omphalia hepatica* (Batsch) Fr., *Pleurotus salignus* (Pers.) Fr., *Naucoria sobria* Fr., *Crepidotus rubi* Berk., *Cortinarius (Inoloma) alboviolaceus* (Pers.) Fr., *C. (Dermocybe) orellanus* Fr., *C. (Telamonia) flexipes* (Pers.) Fr., *Gomphidius gracilis* Berk., *Lactarius uvidus* Fr., *L. theiogalus* (Bull.) Fr., *Lentinus scoticus* B. & Br., *Polyporus elegans* Fr. var. *nummularius* Fr., *Poria micans* (Ehrenb.) Fr., *P. Vaillantii* (DC.) Fr., *Sistotrema confluens* (Pers.) Fr., *Radulum deglubens* B. & Br., *Corticium anthochroum* (Pers.) Fr., *Cyphella muscigena* Fr., *Keithia tetraspora* (Phil. & Keith) Sacc., *Mollisia versicolor* (Desm.) Phil., *Cucurbitaria lauro-cerasi* Phil. & Plow., *Hypocopra capillifera* (Curr.) Sacc., *Valsa dissepta* (Fr.) Tul., *Fenestella bipapillata* (Tul.) Sacc., &c.

Between Altyre and the town of Forres lie the Sanquhar Woods, where many notable discoveries have been made. Here have been found *Tricholoma acerbum* (Bull.) Fr., *Mycena elegans* (Pers.) Fr., *Hebeloma longicaudum* (Pers.) Fr., *Coprinus tomentosus* (Bull.) Fr., *Cortinarius (Inoloma) arenatus* (Pers.) Fr., *Marasmius fuscopurpureus* Fr., *Trogia crispa* Fr., *Porothelium Keithii* B. & Br., *Cyphella albo-violascens* Karst., *Patellaria compressa* (Pers.) Phil., *Helotium ochraceum* (Grev.) Berk., *Melanospora caprina* (Fr.) Sacc., *Fenestella vestita* (Fr.) Sacc., *Diaporthe leiphaemia* (Fr.) Sacc., *D. quadrinucleata* (Curr.) Sacc., *Lasiosphaeria scabra* (Curr.) Awd., *Teichospora obducens* (Fr.) Fckl., *Sordaria discospora* (Awd.) Fckl., *Coprolepa equorum* Fckl., *Melomastia Friesii* Ntke., *Lophiotrema hederae* (Fckl.) Sacc., *Anthostoma xylostei* (Pers.) Sacc., *Kalmusia hypotephra* (B. & Br.) Sacc., *Leptosphaeria abbreviata* (Cke.) Sacc., *Didymella proximella* (Karst.) Sacc., *Pilidium fuliginosum* (Fr.) Awd., *Steganosporium cellulosum* Corda, &c.

At Chapelton, in the neighbourhood of Sanquhar, have occurred *Clitocybe vermicularis* Fr., *Hydnum fragile* Fr., and *H. melaleucum* Fr., as well as perithecia of *Hypomyces chrysospermus* Tul., rarely found in a fully developed condition.

The Cluny hills, situated on the south-east side of Forres, form one of the most popular resorts of visitors to the town. They are wooded from base to summit, and laid out with many paths. On the top of the highest hill of the group has been erected a monument to Lord Nelson, 70 feet in height, and

attaining at the summit of the tower an elevation of 320 feet above sea-level. Under the shade of the trees and coppices on these hills have been found *Tricholoma bufonium* (Pers.) Fr., *Clitocybe pithyophila* Fr., *Inocybe trechispora* Berk., *I. hiulca* Fr., *Hypholoma Candolleanum* Fr., *Helotium sulphuratum* (Schum.) Phil., *Melanospora vervecina* (Desm.) Fckl., and *Diaporthe velata* (Pers.) Ntke.

As might be anticipated from Dr. Keith's habits of minute and careful observation, the Fungi reported from Forres itself, and from the river-side and other places near the town, are very numerous. Among many noteworthy species, reference may be made to *Lepiota sistrata* Fr., *Tricholoma immundum* Berk., *T. humile* Fr., *Clitocybe tumulosa* Kalchbr., *Mycena prolifera* (Sow.) Fr., *M. speirea* Fr., *M. hiemalis* (Osbeck) Fr., *Omphalia demissa* Fr., *Volvaria gloiocephala* (DC.) Fr., *V. speciosa* Fr., *Pholiota mycenoides* Fr., *Inocybe obscura* (Pers.) Fr., *I. eutheles* B. & Br., *Flammula hybrida* Fr., *F. inopoda* Fr., *Naucoria pediades* Fr., *Psathyra conopilea* Fr., *Cortinarius (Phlegmacium) serarius* Fr., *C. (Telamonia) impennis* Fr., *C. (T.) incisus* (Pers.) Fr., *C. (Hygrocybe) scandens* Fr., *Hygrophorus agathosmus* Fr., *H. leporinus* Fr., *Panus conchatus* Fr., *Hydnum scabrosum* Fr., *Cyphella ochroleuca* B. & Br., *Clavaria uncialis* Grev., *Nidularia confluens* Fr., *Puccinia silenes* Schröt., *P. Andersoni* B. & Br., *Anixia perichaenoides* (Cke.) Sacc., *Phacidium seriatum* (Lib.) Mass., *Patinella flexella* (Phil.) Sacc., *Tympanis pinastri* Tul., *Schweinitzia rufo-olivacea* (A. & S.) Mass., *Phaeangella subnitida* (Cke. & Phil.) Mass., *Ombrophila brunnea* Phil., *Ascophanus subfuscus* Boud., *Pseudopeziza arenivaga* (Desm.) Mass., *Ps. palustris* (Rob.) Mass., *Ps. sphaeroides* (Desm.) Mass., *Mollisia albula* Phil., *Belonidium ventosum* (Karst.) Phil., *B. lacustre* (Fr.) Phil., *B. pullum* Phil. & Keith, *Helotium Fuckelii* Mass., *H. concolor* (Phil.) Mass., *H. alniellum* Karst., *H. eburneum* (Rob.) Gill., *H. strobilinum* (Fr.) Mass., *Ciboria subularis* (Bull.) Sacc., *Lachnea bulbo-crinita* Phil., *Dasyscypha rhytismatis* Sacc., *D. acuum* (A. & S.) Sacc., *D. nidulus* (Schm. & Kze.) Mass., *D. oedema* (Desm.) Mass., *D. elaphines* (B. & Br.) Mass., *Humaria xanthomela* (Pers.) Sacc., *H. Keithii* (Phil.) Sacc., *Peziza sepiatra* Cke., *Morchella conica* Pers., *Sordaria curvula* de Bary, *S. maxima* Niessl., *Delitschia bisporula* (Crouan) Hans., *Lasiosphaeria scabra* (Curr.) Awd., *Melanomma Jenynsii* (B. & Br.) Sacc., *Zignoella pulviscula* (Curr.) Sacc., *Z. insculpta* (Fr.) Sacc., *Ceratostomella pilifera* (Fr.) Wint., *Sphaerella anarithma* (B. & Br.) Cke., *Metasphaeria persistens* B. & Br., *Leptosphaeria nigrans* (Desm.) Ces. & de Not., *Pleospora nigrella* (Rabh.) Wint., *P. rubicunda* Niessl., *P. infectoria* Fckl., *Ophiobolus herpotrichus* (Fr.) Sacc., *Massarina tiliae* (Phil. & Plow.) Sacc.,

Phomatospora Berkeleyi Sacc., *Diaporthe inquilina* (Wallr.) Ntke., *D. vepris* (de Lacr.) Fckl., *D. Badhami* (Curr.) Sacc., *D. ceramblicola* (B. & Br.) Sacc., *Valsa abietis* Fr., *V. Kunzei* Fr., *Phoma malorum* Berk., *Vermicularia atramentaria* B. & Br., *Prosthemium stellare* Riess., *Septoria castanicola* Desm., *S. adoxae* Fckl., *S. graminum* Desm., *Amerosporium macrotrichum* (B. & Br.) Sacc., *Ovularia doronici* Sacc., *Torula ulmicola* Berk., *Helminthosporium folliculatum* Corda, *H. Smithii* Br. & Br., *Cercospora calthae* Cke., *Dendryphium laxum* B. & Br., *Stemphylium alternariae* (Cke.) Sacc., *Macrosporium delicatulum* (B. & Br.) Mass., *Fusarium obtusum* Sacc., and *F. rhabdophorum* B. & Br.

In most localities, a scanty rainfall is usually associated with a correspondingly diminished crop of Fungi. This does not appear to be the case at Forres, however, where the average rainfall is believed to be about the lowest in Scotland and one of the smallest in Britain. To an exceptionally favourable climate, and a fertile soil well-fitted to retain moisture, must therefore be attributed the wonderful productiveness of the country around Forres. That the resources of the Moray district, already so largely drawn upon by Dr. Keith, are not yet exhausted, is evident from the results of the Society's visits to Speyside, Drumnadrochit, and Forres; and there is no reason to doubt that fresh discoveries will continue to reward the researches of every mycologist who may be tempted to make that delightful region the field of his investigations.*

* For further information regarding the fungi of Moray, with details as to habitats, localities, etc., reference may be made to Dr. Keith's Lists and the "Mycologia Scotica," already mentioned; and to successive volumes of the "Scottish Naturalist," containing several Supplements to "Mycologia Scotica," as well as lists by Professor Trail of the Scottish Peronosporaceae, Ustilagineae, Uredineae, Discomycetes, Sphaeropsideae, and Melanconieae, with various other short notes relating to the subject; and also to the Society's Transactions, containing lists of species observed at former forays in the district.

PHAEANGELLA EMPETRI BOUD. (IN LITT.) AND SOME FORGOTTEN DISCOMYCETES.

A CORRECTION.

By A. Lorrain Smith, F.L.S.

My attention was called last September by Professor Trail to the description of *Cenangium Empetri* Phill. published in the Scottish Naturalist 1891, p. 89, which seemed to him to tally with that of *Phaeangella Smithiana* Boud. published in the Transactions as a new species. Professor Trail had collected the fungus along with some other Discomycetes at Birsay, in Orkney, in August, 1888, and had sent them all to Mr. W. Phillips for identification and description. The original diagnoses of the plant as given by Phillips did not agree with the characters of Boudier's species; but as Phillips' collection of fungi has recently been incorporated in the herbarium of the British Museum, the type specimen was found and re-examined microscopically. The fungus on which Phillips based his determination must have been immature, as he placed it in a genus with colourless and simple spores. Examples were found, however, of brown septate spores similar to those of *Phaeangella* and, as the other characters agreed, M. Boudier was communicated with and has authorized the substitution of Phillips' prior specific name.

It has been considered that it would be of service to workers to republish the other new Orkney species which had, along with the above, escaped inclusion, not only in Mr. Massee's Fungus Flora, but also in Saccardo's Sylloge. The previously described species *Mollisia carduorum* and *Ascobolus stictoideus* have since been recorded as British, the former by Massee (Brit. Fung. Fl. IV. p. 496 (1895) and the latter by Crossland (Naturalist 1900, p. 8). I wish to express my thanks to Professor Trail for pointing out the mistake and to M. Boudier for his cordial permission to correct the specific name.

The Orkney species as originally published by Phillips in the Scottish Naturalist are as follows:—

HYMENOSCYPHA SYMPHORICARPI, N.S.

Scot. Nat. 1889, p. 139, No. 105, as *Hymenoscypha aurea* (Pers.).

Cups scattered, stipitate, cupulate, then expanded, plane, glabrous, or minutely tomentose on the sub-bulbous slender stem; margin entire; bright yellow throughout; asci cylindrical, narrowed at the base; sporidia oblong or oblong-fusiform, rather obtuse, a gutta at each pole; paraphyses filiform, slender.

On dead branches of *Symphoricarpus racemosus*, Binscarth.

Cups 300-500μ broad, stem 300-1000μ long; asci 60 x 7μ. This is a slender delicate species, which does not agree well with any described species. It comes near *Phialea vitellina* (Rehm) Sacc., but differs in the sporidia, and tomentose sub-bulbous stem.

MOLLISIA (PYRENOPEZIZA) CARDUORUM (REHM).

Pyrenopeziza Carduorum Rehm, Ascom. No. 68; Winter, in Flora, 1872, p. 526; Saccardo Syll. Fung., Vol. VIII., p. 359.

On *Carduus lanceolatus*, Binscarth.

MOLLISIA (NIPTERA) CINERELLA, SACC. f. CAESPITOSA, mihi.

On decorticated wood of *Fagus sylvatica*, Binscarth.

The cups break out in caespitose heaps: the sporidia are clavato-fusiform, and are furnished with a gutta near the ends.

LACHNELLA ORBICULARIS, n. sp.

Minute, scattered, erumpent, sessile, orbicular, when dry black, when moist fuliginous, clothed near the margin with short, fuliginous, asperate hairs; asci subfusiform, broad; sporidia eight, fusiform, pointed at the ends, triguttulate, 10-14 x 2-2·5μ; paraphyses acerose, a little exceeding the asci in length.

On dead culms of *Juncus squarrosus*. Greenay Hill in Birsay.

Cups 100-200μ broad, asci 35-38 x 7μ; paraphyses 40-43 x 2·5μ. This has many points in common with *Dasyscypha Rehmii* (Staritz) Sacc.; but differs in being perfectly sessile and much smaller in size.

LACHNELLA BRUNNEO-CILIATA, n. sp.

Scattered, stipitate, cupulate, dark brown; margin ciliated with dark brown asperate hairs; hymenium pale-cinereous; asci cylindraceo-clavate; sporidia eight, oblong-elliptic, or sub-cymbiform, obtuse, uniseptate, 12-14 x 3-4μ; paraphyses acerose, broad, exceeding the asci.

On dead culms of *Juncus squarrosus*. Shore of Loch of Banks in Birsay.

Cups 300-600μ broad; stem equalling in length the diameter of the cup; hairs 60 × 4μ; asci 65 × 7μ; paraphyses 80 × 5μ. This is quite distinct from *Dasyscypha Rehmii* (Star.) Sacc.

LACHNELLA (HELOTIELLA) LABURNI, n. sp.

Cups minute, scattered, sessile, at first globose, urceolate, dirty white or pale brown, margin ciliated with pale brown hairs; asci cylindraceo-clavate, or clavate; sporidia 8, oblong, obtuse, uniseptate, slightly constricted, hyaline, 13 × 5μ; paraphyses slender, sparse.

On twigs of *Cytisus Laburnum*, Binscarth.

The cups are 200μ broad, urceolate; the hairs are non-septate, paler near the base, 60-65μ long, 3μ broad; the asci are 70 × 10-12μ.

It is remarkable that on the branches of *Cytisus radiata*, in Northern Italy, a minute species, *Niptera Raineri* (De Not.) Sacc., occurs with very similar sporidia. I cannot suppose, however, that they are the same plant, as De Notaris has said nothing about the margin of *N. Raineri* being ciliated.

ASCOBOLUS STICTOIDEUS SPEG.

Michelia, Vol. I., p. 474. Saccardo's *Sylloge Fungorum*, VIII., p. 515.

Cups loosely gregarious or scattered, minute, scarcely 1/3-½ mm. in diameter, externally watery white, the disc pale-olivaceous, nigro-punctate with the projecting asci, totally immersed in the substratum or with the thick torn margin exposed; asci few (5-10), large, 150-160μ × 40μ, short and widely clavate, the wall thickened above with a stout stalk, 8-spored; paraphyses septate curved at the tips; spores in two rows, or irregularly grouped; ellipsoid 25μ × 14μ, at first hyaline and smooth, then violet.

On dog's dung at Howan, in Birsay.

CENANGIUM EMPETRI n. sp.

Cups scattered, minute, at first nestling beneath the epidermis, then erumpent, subturbinate, or barrel-shaped, margin connivent, then erect, torn; externally vertically wrinkled, granular, black, coriaceous; hymenium nearly black; asci cylindraceo-clavate; sporidia 8, elliptic, becoming fuliginous grey, 15-17 × 7-9μ; paraphyses filiform, occasionally branched.

On dead leaves of *Empetrum nigrum*.

Cups 300μ broad in the widest part, and the same in height; asci 100 × 15μ, cell-wall conspicuous.

SOME NOTES ON THE HISTORY OF THE CLASSIFICATION OF THE UREDINALES.

By J. Ramsbottom, B.A.

The Uredinales are a group which seem to give rise to more problems that do any other group of fungi. One has only to think of, amongst others, the problems of heteroecism, biological species, polymorphism and the relations with other groups to understand the attraction the group has, even for those botanists who have not otherwise the slightest interest in mycology. The Uredinales were amongst the earliest microscopic fungi to be noticed because of their attacks upon cereals. In the words of Persoon, " Plusieurs sont connues même du vulgare par le dommage qu'elles occasionent." In recent years, some people interested in their study have counted the number of times rusts are mentioned in the Old Testament, the infliction of blight or blasting being regarded as one of the Divine judgments for the sins of the people. The number seems to be at least five, the first occurring in Genesis. The reference in the New Testament to the "corruption" caused by "moth" and "rust" seems to have no phytopathological significance. We know that the Greeks and Romans were familiar with these diseases and it seems certain that any nation which cultivated cereals had at least a nodding acquaintance with what could, in such a mysterious way, cause such a difference in the crops upon which they so much depended. The nature of the disease was of necessity quite unknown to the ancients, but theories and assertions were never lacking.

As an example of what a competent naturalist of the 17th century thought of the subject one may take the case of Robert Plott, LL.D., Keeper of the Ashmolean Museum and "Professor of Chymistry" in the University of Oxford. Writing in 1686 in his book on the Natural History of Staffordshire (a book I have to thank Miss Lorrain Smith for calling my attention to) he mentions that to avoid blasting and smutting, the inhabitants of the county steeped "their grain in brine before they sowe it," and that (to prevent Meldewing, the most pernicious of all the annoyances, that inclosures and rich lands are lyable to, Thomas Cartwright, parish Clerk of Womburn, in this County, either mixes his corn with soot before he sowes it, or sowes soot upon

it after the wheat's in the ground: by which means he has preserv'd the corn from being Meldewed, in lands always observed to have been lyable to it, and this not for one or two, but for ten years together." He therefore looks "into the causes of this annoyance" and also how it comes to pass that this treatment "proves a Medecin for it."

"First then, as to the causes of Meldews some have thought them much occasioned by an unseasonable time of sowing, and therefore have sown very early, as judging corn most subject to this disease when sown late: but this cause is certainly but ill grounded some land meldewing at what time soever they are sown. Others again have placed the origin of meldewing in making small inclosures, corn not being so lyable to this evil in the common open fields: which tho' it must be confest in part, yet this can but be an accidental cause at most: for let the inclosures be never so small, so the land be poore the corn that it bears shall rarely be meldew'd. It remains therefore that the adequat original cause of this malady, must be in the richness of the soile, especially if not naturally, but made such by dung, which fattening it, and sending up a moist viscous steam, that upon congelation in the Air falls down upon the corn again in a dew of the sweetness and consistence of hony, and there sticking to the straw, and further harden'd by the Sun, so binds up the pores of it, that the nourishing juice in great measure is prevented thereby, ascending to the ear: whence the grain becomes shrank as we commonly see it in all corn affected with this distemper. And this I take to be the true origin, and process of Meldewing. Now if this steam when ascended, be anyway hindered, being dispersed by the wind, or shaken off the stalks of the corn, when fallen on them, by the height or narrowness of inclosures, it must be owned that they are thus farr an accidental social cause of Meldews: but for their true original I believe it to be nothing else but that viscous steam rais'd by the heat of the Sun out of the fattness of the dung, which is suck't up, or kept down by any adust matter, that it cannot ascend at all, as I suppose it is by the soot, the annoyance thereby is fully prevented." Where there is not sufficient soot for treatment he suggests "sowing bearded wheat, whose ailes catching the dew, do prevent in great measure its falling on the straw and doeing the mischief above mention'd."

As is well known Jethro Tull, the father of modern agriculture, in his book on "The Horse Hoeing Husbandry," as late as the third edition in 1751, attributes the attack to small insects "brought (some think) by the east wind" which feed upon the wheat leaving their excreta as black spots upon the straw "as is shown by the microscope."

Fontana in 1767 seems to have been the first to establish the

fungoid nature of the wheat rusts. He gives figures of the teleutospore and uredospore stages. He regarded them as rootless plants which exhausted the wheat and stated that no remedy was possible until a careful study of all the phases of the disease had been made.

Ninety years before this, however, Robert Hooke in his famous work *Micrographia* had decided that the rust on damask rose leaves must be a plant and gave an illustration of it.*

The idea that the rusts were parasitic fungi was not generally accepted until well into the 19th Century. This need occasion no surprise when it is considered what strange ideas were prevalent in certain other branches of botany.

The earliest British Floras contain very few references which can be interpreted as referring to Uredineae. Probably the first occurs in the 3rd Edition of Ray's Synopsis, 1724. This edition, which was published over twenty years after Ray's death, was edited by Dillenius, who was afterwards the first Sherardian professor of botany at Oxford. The editor's name did not, however, appear on the title page, as there was (in the words of Dillenius) "some apprehension (my being a foreigner) of making natives uneasy." The additions are, however, marked. Amongst these additions is given "Filix lobata, globularis pulverulentis undique aspera," and the remark that this singular fern was observed in the herbarium of Bobart, where the latter had himself written "This Capillary was gathered by the conjurer of Chalgrave." There is a figure given of the plant which is the leaf of *Anemone nemorosa* attacked by an aecidium. The plant even now is sometimes called "the conjurer of Chalgrave's fern." Who the conjuror was I have been unable to find out, but his place of residence was Chalgrove, the scene of John Hampden's death, and not Chalgrave, if Dillenius' statement that the village is situated seven miles from Oxford is correct. In Druce's Flora of Oxfordshire the name is spelled Chalgrove and it is stated that the original plant is in the Morisonian Herbarium at Oxford. Mr. Druce, however, now informs me that the specimen has been lost, probably during the removal of the collection from the old Sherardian rooms to the present Fielding Herbarium. The Bobart "imposed upon" and given the plant "either ignorantly or in wantonness" is Jacob Bobart the younger, who was the collaborator of Morison (the first Regius professor of Botany at Oxford), and afterwards his successor, who gained fame by transforming a dead rat into the feigned figure of a dragon, which imposed upon the learned so much that "several fine

*Trans. Brit. Mycol. Soc., Vol. iii., pp. 19-20 (1908).

copies of verse were wrote on so rare a subject:" and not Jacob Bobart the elder, who was superintendent of the Oxford botanic garden and who, on rejoicing days, used to have his beard "tagged with silver."

John Hill, in his British Herbal of 1756, under *Anemone nemorosa,* points out Dillenius' error stating that "a small winged insect is apt to deposit its eggs on the underpart of the leaves of this species, and they somewhat resemble the round dots in which the seeds of ferns are lodged. A leaf of it thus decorated is unluckily represented in a figure in the last edition of Ray's Synopsis. The form, substance and disposition of these dots ought to have informed the botanist they were not seeds."

Richard Pulteney, in a paper read before the Linnaean Society in 1792, traces the history of the knowledge of this diseased *Anemone.* He had known the plant for many years but had never troubled about it, having rested in the opinion which he "had met with in several modern authors that the Tubercula or Puncta, as they have been most commonly styled, on the leaves of *Anemone nemorosa,* were the eggs of an insect." He found on examination, however, that the tubercles were themselves a vegetable production of a parasitical kind of the order of fungi," and considered the cause of the disease to be a *Lycoperdon—L. anemones.* He found he could trace the knowledge of such a diseased plant back to the Sylva Hercynia of Thalius, 1585, where it is considered as a distinct species of *Ranunculus,* the infected plants always being sterile: and that Maurice Hoffmann as early as 1662 had ascribed the appearance to the work of insects. It is probable that Pulteney was describing *Aecidium leucospermum,* whereas the Conjurer of Chalgrave's Fern was *Aecidium fuscum,* according to Baxter, "on the authority of the original specimen in Bobart's Herbarium." Pulteney states that the then professor of Botany at Oxford had informed him that he had seen among Dillenius' papers a correction of the mistake by Dillenius himself.

The aecidium on *Tussilago* early attracted attention and was given the name *Lycoperdon epiphyllum* in Linnaeus' Species Plantarum 1753. In the same work *Gymnosporangium juniperinum* appeared under the name *Tremella juniperina.*

Lycoperdon epiphyllum was an extremely convenient species. Any aecidium for a time was placed here, but what more could be expected when the examination was conducted, say, "with one of Mr. Adams's pocket lenses of three glasses united."

In British Floras we first find the name occurring in Lightfoot's Flora Scotica published in 1777. It is given as occurring on dead leaves, moss and rotten wood, and is a species of *Trichia.*

The rusts are mentioned incidentally in the 1st edition of Withering's Botanical Arrangement, 1776, where, in speaking of *Berberis* he states:—"This shrub should never be permitted to grow in corn lands, for the ears of wheat that grow near it never fill, and its influence in this respect has been known to extend as far as 300 or 400 yards across a field." In the 2nd edition, 1792, we find *Lycoperdon epiphyllum* in its proper sense and a statement to the effect that it is not Lightfoot's *L. epiphyllum* which is *Trichia turbinata*.

In the 3rd edition of this work, 1796, the number is increased by the addition of *Lycoperdon innatum* growing on *Anemone nemorosa*, *Adoxa*, *Carduus arvensis*, and *Betonica officinialis*. These hosts are copied from Relhan's Flora of Cambridge: the description is really that of *Aecidium leucospermum*, but there is given in the synonomy *Aecidium fuscum* and the *Conjuror of Chalgrave's fern*. *Gymnosporangium Sabinae* occurs as *Tremella Sabinae* amongst algae and true Tremellas, just as the genus *Lycoperdon* also included true Lycoperdons and certain Myxomycetes.

In the 4th edition (1801), edited by Withering's son, we find under *Lycoperdon epiphyllum* a note which, from the date given, seems to be one by Withering himself. "The spots on *Sorbus aucuparia* consist of minute globules intermixed with wool-like fibres. On examining many of them in different states I at last found a small maggot in some of the younger spots, so that the globules are probably its excrement, and the fibres the woody fibres of the plant unfit for food." So much for *Gymnosporangium juniperinum*.

In the 7th edition, 1830, there is no alteration in the two species of *Lycoperdon* but five species of *Uredo* are given, and this only six years before the appearance of Berkeley's contribution to Smith's English Flora. Withering, in his Preface to this edition, apologises for the paucity of Cryptogamic material presented. He is evidently quite out of sympathy with "this overgrown class." "Experience warrants the conclusion that individuals far more highly gifted have hitherto failed to reduce these countless tribes to systematic order." Mycological studies especially "cannot be rendered palatable to the generality of Botanists. . . Experience evinces that this particular branch of science is almost daily becoming and must inevitably become, even to the proficient, a separate study, fully available only to the lynx-eyed few." By taking such a view Withering contrived to include just the same number of Uredineae for the whole of the British Isles as Relhan had in the Flora of Cambridge ten years before.

Persoon was the first to bring about anything like order in the study of the rusts. So much so that by the International Rules

Persoon's Synopsis (1801) is to be the starting point for the nomenclature of this group.

Puccinia, Uredo and *Aecidium* were three genera founded by Persoon. The first genus to be diagnosed was *Aecidium*, the diagnosis of which appeared in Gmelin's Linné Systema Vegetabilium, 1791. Eighteen species were described, including *Aecidium berberidis, A. tussilaginis* (given as equalling Linnaeus' old species *Lycoperdon epiphyllum*) and *Aecidium candidum*. The name *Aecidium* had previously been used by Hill in his History of Plants, 1751. Hill gives a description of his genus. It has a "tolerably firm structure and marked with round protuberances on the surface which are the coverings of certain cells . . . of the same nature with those of" *Xylaria*. It was because of the flask-shaped perithecia he bestowed the name. "We have called," he says, "this genus distinguished by its peculiar cells *Aecidium*, from the Greek οἰκίδιον, cellula." (Persoon did not correct the spelling of the name.) The genus includes certain large Pyrenomycetes such as *Nummularia*. The species grow either in the clefts and fissures of old trees or between the bark and the wood. Three species are fully described—male and female organs as well. The other species, ten in number, "will be easily distinguished by their names: they are the white thick Aecidium, the black thinner Aecidium, the hairy grey Aecidium growing on old Oaks," and so on. In spite of Hill's assertion no European botanist would pretend to know what these easily distinguished species are. This method of description is quite typical of John Hill, Sir John* as he called himself, being a member of the Swedish order of Vasa. He was a very versatile person, being somewhat of a player, apothecary, poet, botanist, playright, and, according to his contemporaries, rogue. He had controversies with very many notable people. Dr. Johnson had a very decided opinion about him. Christopher Smart, following some anonymous abuse by Hill of his work, composed "The Hilliad: an epic poem," in which he indulged in some rather free expressions. David Garrick wrote the famous couplet concerning him, "For physic and farces, his equal there scarce is, His farces are physic, his physic a farce is." He obtained the appointment of Superintendent of the Royal Gardens at Kew: the grant, however, does not appear to have been confirmed. He was a most voluminous writer and wrote the first Linnaean Flora of Britain. Concerning his botany Sir J. E. Smith wrote "sometimes, as Linnaeus says, a blind hen meets with a grain of corn."

Uredo was diagnosed in 1794 and four species given. They

* Mr. Claridge Druce has called my attention to a passage in Gent. Mag. 1774, p. 282, from which it is apparent that George III. acknowledged the title, for Hill, "was received at Court with the proper ensigns as knight."

are all good Uredos. The date usually given for *Uredo*, however, is 1795, when Persoon diagnosed the genus again. He was less successful this time. He described three species, the first two of which, *Uredo candida* and *Uredo mycophila*, are not now included in the Uredinales, the first being *Cystopus candidus* and the second *Sepedonium chrysospermum*.

The date, 1794, is also the correct one for the first use by Persoon of the name *Puccinia*. He described five specimens. The name *Puccinia* was first used by Micheli in his Nova Plantarum genera, 1729, the name being given in honour of Professor Puccini of Florence. Two species were described and figured, the one *Puccinia non ramosa, &c.*, being the present *Gymnosporangium juniperinum*, the other, *Puccinia ramosa, &c.*, being the Myxomycete *Ceratiomyxa fruticulosa*. The name *Puccinia* occurs several times between Micheli and Persoon in Micheli's sense, but Persoon redefined the genus taking out the myxomycete and adding a *Phragmidium* and three species of *Puccinia*, one of which is the famous *Puccinia graminis*. Link afterwards took out the *Uredo mucronata* (the *Puccinia non ramosa* of Micheli) and made it the type of his genus *Phragmidium*. No one apparently ever used the genus *Aecidium* in Hill's sense. Possibly the man who was forbidden Chelsea Physic Garden "for making too free use of the plants" could not be trusted to describe merely what he saw.

In the Tentamen, 1797, Persoon widely separated *Puccinia* from *Uredo* and *Aecidium*, which two he had placed together from the first. In his Synopsis he divides the fungus group into two classes, Angiocarpi and Gymnocarpi. The former class is divided into three orders, Sclerocarpi, Sarcocarpi and Dermatocarpi. The section Trichospermi of the last order includes the Gasteromycetes and Myxomycetes, while the section Gymnospermi includes *Aecidium*, *Uredo* and *Puccinia*, together with such genera as *Licea*, *Onygena* and *Trichoderma*. (The third section, Sarcospermi, includes only *Cyathus*). The grouping together of *Aecidium*, *Uredo* and *Puccinia* is the germ of the modern cohort Uredinales. The classification put forward in the Synopsis was followed by Albertini and Schweinitz in their Conspectus Fungorum, 1805, and by Sir W. J. Hooker in his Flora Scotica, 1821. In the Flore Française, 1805, De Candolle divided the fungi into Persoon's two main divisions, Angiocarpi and Gymnocarpi. He then subdivides the Angiocarpi into those genera without peridia (*Gymnosporangium*, which is here first diagnosed, *Puccinia* [species classified according to the number of compartments in the spore], *Bullaria* [*Puccinia*], *Uredo*); those genera with peridia in which there are no filaments (*Aecidium*, *Mucor*, *Licea*, *Tubulina*) and a third group where there are such filaments (Myxomycetes and Gasteromycetes).

The first reference which the present writer has been able to find to the Uredineae as a group occurs in Persoon's Traité sur les Champignons, 1818. It is not defined but he says "Une autre petite famille très-naturelle et très-riche en espèces est celle des *Urédinées*, toutes parasites sous l'épiderme des feuilles encore vertes, rarement sur les branches sèches, et quelques-unes dans les épis des céréales. . . Leur poussière est en proportion de leur petitesse très-abondante, mais sans filets; elle est aussi souvent dépourvue d'un péridié, et dans ce cas elle est entourée d'une partie de l'epidermie de la plante-mère, qui en fait la fonction, étant modifiée en faux-péridié. Leur grains paroissent être des capsules propres, qui dans le genre Puccinia sont cloissonnées. Les *Puccinia*, *Podisoma* Link., ou *Gymnosporangium* Decand.; les *Uredo* (Ustilago) et *Aecidium* (Roestelia), sont les genres les plus connus de cette division."

At this time *Puccinia*, *Uredo* and *Aecidium* were usually regarded as separate genera though certain botanists began to have serious doubts upon the subject. In the words of Sachs, "The lower, the small and simple Fungi, those especially which are parasitic on plants and animals, were the most attractive objects in the whole field of mycology. Here were difficulties in abundance, here were the darkest enigmas with which botany has ever had to deal, here was new ground to be slowly won by extreme scientific circumspection and foresight. In these forms, as in the Algae, the first thing to be done was to make out the complete history of development in a few species; but it was more difficult in the Fungi than in the Algae to discover what properly belonged to one cycle of development and to separate it from casual phases of development of other Fungi."

Sir Joseph Banks, in 1805, wrote a most interesting letter on the Blight in corn, which he distributed to those interested in Agriculture; it was afterwards republished in several scientific journals. Banks was then President of the Royal Society. It may be of interest to some to learn that the Department of Botany at the British Museum was originally known as the Banksian department and was established for the reception of the herbarium of Banks, who shortly before his death in 1820, bequeathed it to Robert Brown. When Brown died it was to become the property of the British Museum, although with Brown's consent the herbarium might be, and as a matter of fact actually was, removed to the Museum during his life-time. The books in the Department are always stamped on their cover with a representation of the genus *Banksia*.

In Banks' letter he suggests that the uredo and the teleutospore stage are connected though he does not definitely state how. He probably did not understand the proper nature of the relation. "It seems probable that the leaf is first infected in

the spring, or early in the summer, before the corn shoots up into straw, and that the fungus is then of an orange colour: after the straw is become yellow, the fungus assumes a deep chocolate brown." He thought the teleutospores contained a large number of seeds, "a sort of animated dust." Taking account of the large number of these spores he gives a very good idea of the struggle for existence. "Providence, however, careful of the creatures it has created, has benevolently provided against the extensive multiplication of any species of being; was it otherwise, the minute plants and animals, enemies against which man has the fewest means of defence, would increase to an inordinate extent; this, however, can in no case happen, unless many predisposing causes afford their combined assistance. But for this wise and beneficent provision, the plague of slugs, the plague of mice, the plagues of grubs, wire-worms, chafers, and many other creatures whose powers of multiplying is countless as the sands of the sea, would, long before this time, have driven mankind and all the larger animals, from the face of the earth." He also considers the case of the relation between the aecidium stage on Barberry and the stages on wheat. "It has long been admitted by farmers, though scarcely credited by botanists, that wheat in the neighbourhood of a barberry bush seldom escapes the Blight. The village of Rollesby, in Norfolk, where barberries abound, and wheat seldom succeeds, is called by tne opprobrious appellation of Mildew Rollesby. Some observing men have of late attributed this very perplexing effect to the farina of the flowers of the barberry, which is in truth yellow, and resembles in some degree the appearance of the rust, or what is presumed to be the Blight in its early state. It is, however, notorious to all botanical observers, that the leaves of the barberry are very subject to the attack of a yellow parasitic fungus, larger, but otherwise much resembling, the rust in corn. Is it not more than possible that the parasitic fungus of the barberry and that of wheat are one and the same species, and that the seed transferred from the barberry to the corn, is one cause of the disease? Mistletoe, the parasitic plant with which we are the best acquainted, delights most to grow on the apple and hawthorn, but it flourishes occasionally on trees widely differing in their nature from both of these."

To the 2nd edition of Banks' letter, 1806, there is appended a letter from the famous horticulturist Thomas Andrew Knight, who afterwards became President of the Royal Horticultural Society, and who is well known to elementary students of physiological botany through their wearying efforts to understand the theory of Knight's wheel.

Knight writes as follows:—"An opinion prevailing very

generally in this, as in other districts, that the barberry tree communicates disease to wheat and other plants in its vicinity, I sowed, in the autumn of 1804, a row of wheat round a plant of that kind, which grew in my garden, the soil of which is a shallow loam or a limestone gravel; and I also sowed several small portions of seed of the same kind in a meadow, the soil of which was very similar to that of my garden, though situated at a considerable distance from it. All the plants continued perfectly healthy till the beginning of July, when those near the barberry bush showed evident symptoms of disease. . . . Examining the barberry bush attentively, I found upon its fruit a species of fungus similar in colour to that on the straws of the wheat; but its seed vessels were larger, and more spherical. I was, however, much disposed to believe the parasitical plants of the same species, and that the difference in the form and size of the seed vessels arose only from the difference of the nutriment they derived from the wheat, and from the acrid juice of the barberry. The plants of wheat, which grew at a distance from the barberry bush, remaining free from the disease, I carried a branch of barberry, with diseased fruit upon it, to one of them, and wetting it with water, I brushed the wheat plants with it, repeating this operation three successive days. I at the same time applied a part of the diseased straws which had grown near the barberry bush, to other plants of wheat, which were free from disease, leaving upon them so large a portion of the seeds and seed vessels of the mildew, as to be visible without the aid of a lens. In the course of ten days the plants of wheat, which I had endeavoured to infect by means of the barberry branches and fruit, became covered with disease, whilst those to which I had applied the mildewed straws were not sensibly affected. I attributed the health of these to the want of moisture necessary to make the seeds of the mildew vegetate, and I therefore sprinkled them plentifully with water in the three succeeding days; and at the end of ten days I found them all diseased as in the preceding cases."

Knight seems to have thus been the first to try inoculation experiments on heteroecism. He sifted his ideas in an intelligent manner, but was quite led astray by his previous notions. He continues: "As water had been applied in each of the preceding experiments, it became necessary to ascertain how far that fluid alone might be capable of inducing disease without the aid either of the barberry, or diseased straws; and I therefore, whilst repeating the experiment last described, sprinkled a remaining portion of plants at the same hour with water only." He significantly adds, "and I was not very much surprised to find that these became as much diseased, within the same period of time, as any of those I have described." He states

that very cold water was applied early in the afternoon of warm and bright days; the ground in which the plants grew was very dry, therefore there was probably a considerable absorption of water, and to this and a sudden change of temperature as secondary causes, Knight was disposed to attribute the appearance of the disease. He does not attempt to solve whether the spores of the fungus were carried by the water or were already there. He states that the applications of water to any plant on which the sun is shining strongly is very injurious to its health and therefore likely to give increased activity to any disease to which the plant is subject. Nevertheless, he holds that "the opinion so generally entertained both in this kingdom and on the continent, by practical farmers, that barberry trees are injurious to corn, deserves very considerable attention." That this was not Knight's first experiment with fungus spores is seen by the note in Sowerby's Fungi, 1803, where under *Farinaria pomacia* it is recorded that he "observed that on shaking the [diseased apple] leaf over a piece of talc or glass he detected little oval bodies which shrivelled a little in drying. Some of these were transferred to other trees, and the disorder along with each, every one producing its own species."

De Candolle (1807) agreed with Banks that the Uredo and Puccinia stages were connected, the *Uredo* becoming a *Puccinia* on further growth, but later he suggested the two might be definite stages in the life history.

Prévost, in a remarkable paper in 1807, records that he has seen *Uredo* and *Phragmidium* in the same sorus. He had at first thought that the spores of *Phragmidium* were male organs. He thinks the mycelium the first stage, from which spring the teleutospores, the uredospores arising in the loculi of these. The important work of Prévost, however, was in connection with the germination of spores. He germinated the uredospores of *Uredo linearis* and *Uredo Alliorum*. On germinating the spores of *Albugo* or *Cystopus candidus*, then called by Persoon's name *Uredo candida*, he found that they gave rise to zoospores, a fact that was taken no notice of by systematists till the time of de Bary.

In the first half of the nineteenth century there were great controversies as to the relation existing between the uredo-stage and the teleuto-stage.

Albertini and Schweinitz stated that *Uredo* always appears before *Phragmidium* and from the fact that sometimes sori occur which consist of pure *Phragmidium*, the latter must develop at the expense of the detritus of the *Uredo*.

Corda, Fries, Schlechtendal and Léveillé on the other hand held that the uredospore was parasitic on the teleutospore.

Eysenhart stated that *Uredo* and *Phragmidium* often live

together without apparent prejudice. His opinion was that the *Uredo* changed into the *Phragmidium*, but this change was not seen because it was brought about too quickly—a very modern-sounding explanation. Schwabe also assented to this explanation and did not even trouble to separate the genera.

Unger did not agree with this idea. He held the two kinds of spores to be contemporaneous and associated productions though independent and holding no necessary relation to one another. He gave seven or eight species of *Phragmidium* habitually accompanied by *Uredo*.

In 1841, Henslow, then professor of Botany at Cambridge, turned his attention to the Uredineae owing to the failure of the candidates for a prize essay offered by the Royal Agricultural Society to bring forth anything of worth. He stated that he had satisfied himself "by direct observation, that the fungus which first produces the orange-coloured spores of *Uredo rosae*, also gives rise to other spores of a very different form . . . (*Aregma mucronatum*)" and talking of Mildew he says: "I have observed this fungus intermixed with the rust-fungi in a way which strengthens my opinion that they are identical." In a later paper of the same year "On the Specific Identity of the Fungi producing Rust and Mildew" he gives additional evidence for this opinion. Also he states: "As the fact of the berberry occasioning some sort of blight in wheat, but more especially mildew, has been forcibly brought before me from several quarters since my last report was written, I am bound to suppose that there must occasionally exist some relation between the presence of this shrub and the occurrence of mildew in wheat. At present I have met with no evidence which can explain the nature of this relation." He suggests, however, that it may be due to some ingredient in the soil, some different form of development belonging to the same fungus or to bad odours!

In 1847 L. R. Tulasne published his first Mémoire on the Ustilagineae and Uredineae in collaboration with his brother. He gives a practically complete résumé of previous work on the structure of the group. He first made clear the nature of the paraphyses in *Phragmidium*, which Unger had thought to be young spores of *Uredo*, Corda had thought to be basidia and Prévost had regarded as young pericarps, from which the uredospores had escaped prematurely.

He also continued the work begun by Prévost on germination. Corda meanwhile had attempted to germinate the spores of *Aecidium Tussilaginis*. Tulasne germinated the spores of *Uredo suaveolens* and *Uredo Rosae;* and asserted definitely that the *Uredo* which was known to accompany *Phragmidium* was a definite spore form of the same species.

In Tulasne's 2nd 'Mémoire' (1854), he definitely proves that

Uredo and *Phragmidium* are different stages of the same species. His previous studies on the polymorphism of other fungi was of great help to him in understanding this problem. If the two are not definite stages of the same fungus then he holds their occurrence together must be accidental and of no physiological character, or one must be a necessary parasite on the other. He thinks the relation too obvious for the first explanation and too close for the second for either to be probable.

Tulasne also studied the spermogonia of the Uredinales, giving this name to them as he had previously done to similar structures in other fungus groups and in Lichens. Unger in 1838 had worked out the structure of these organs and noted that they appeared slightly before the aecidia. He thought they were separate fungi and gave them the name *Aecidiolum exanthematum.* Meyen in 1841 thought they might be male organs, although he fully realised that fertilisation of the ordinary type could not possibly occur in the group. Tulasne agreed with this suggested function, but did not attempt to explain the method of fertilisation. From 1851 he grouped the Uredinales amongst those fungi possessing spermogonia. In 1852 de Bary proved that the spermogonia and the aecidia arose from the same mycelium. It is interesting to note that Sowerby at the beginning of the century had more or less suggested this function for the spermogonia. Speaking of the "troublesome parasite" *Aecidium cancellatum* he states that "This Fungus, which grows under the leaves has been considered as a distinct species; but from these specimens it seems scarcely doubtful that they are analogous to the diœcious class of plants, and are of one and the same species. Those on the upper side of the leaf might have been considered, if alone, as a *Sphaeria*, but as they may belong to the opposite parasite, they must be included as one dioecious species." He adds: "The peculiarities of particular Fungi will afford much entertainment." Tulasne worked out what he called the dimorphism in thirteen genera of the Uredinales and gave the results of his germination experiments with teleutospores, aecidiospores and uredospores, and the determining factors controlling the germination of each. He homologised the promycelium produced on the germination of the teleutospore with the basidium of *Auricularia.*

In 1821 there appeared Gray's Natural Arrangement of Plants, the first of the British Floras to break away from the traditional Linnaean classification. We have seen how the younger Withering, even so late as 1830, had only managed to find room in his four volumes for seven species of the Uredineae. That Gray had a wide conception of what constitutes botany is

shown in a charming manner in the section of his book labelled " Introduction to Botany," where he informs us that " Anne of Cleves, when transformed by Act of Parliament from the wife into the sister of Henry [VIII.], endeavoured to forget the slights of the monarch in the cultivation of vegetables." He includes over fifty species of rusts in his family Protomyceae. The family is divided up into sections. Coeomideae (*Roestelia, Aecidium, Ustilago, Uredo, Albugo* [much better known under Léveillé's name *Cystopus* proposed twenty-six years later], *Coeomurus* [*Uromyces*], *Dicaeoma* [*Puccinia*], *Puccinia* [*Phragmidium*] and *Podisoma* [*Gymnosporangium*]). Stilbosporideae (*Fusidium, Stilbospora*). Xylomideae (*Xyloma* [*Rhytisma*]). Gymnosporangideae (*Gymnosporangium*). Aegeritideae (*Aegerita, Fusarium*) and Tubercularidae (*Tubercularia*).

This classification is very similar to that of Nees von Esenbeck in his System der Pilze (1816-7). Here the fungi are divided into certain groups. The group Protomyci has several divisions, one of which, the Coniomyci has a section Entophyti composed of *Caeoma (Roestelia, Aecidium, Ustilago, Uredo, Dicaeoma), Puccinia* and *Podisoma.* The division Sphaeromyci section Entophyti contains simply *Gymnosporangium.* The Liberi sections of these divisions include such genera as *Fusidium* and *Fusarium.* Martius (Flora Cryptogamica Erlangensis 1817) has a very similar classification. His ' Coniomycetes elementares entophyti ' are the same as Nees' Coniomyci entophyti but *Xyloma* is added: Coniomycetes elementares liberi consist of *Fusidium, Stilbospora,* &c. In the Coniomycetes suffulti the section evoluti contains *Tubercularia, Calycium* and *Gymnosporangium.*

In 1821 Fries began the publication of his Systema Mycologicum. In his introduction he divides the Fungi into Coniomycetes, Hyphomycetes, Gasteromycetes, and Hymenomycetes. The Coniomycetes are then sub-divided into Entophytae, Sporodesmia, Coniosporia and Tuberculariae. The Entophytae are further divided into Hypodermia (parasitic on living plants: *Coeoma, Spilocaea, Phragmidium, Podisoma)* and Stilbosporei (endophytic on dead plants: *Melanconium, Fusidium, Stilbospora, Naemaspora).* Sporodesmia consisted of *Seiridium, Sporodesmium, Exosporium,* and *Gymnosporangium.*

The classification followed in the body of the book (the Coniomycetes were included in the portion published 1832) is somewhat different.

Ordo I. Tubercularini. *Tubercularia, Volutella, Fusarium, Blennoria, Coryneum, Dicoccum, Schizoderma.*

Ordo II. Stilbosporei. *Naemaspora*, *Septoria*, *Fusidium*, *Cryptosporium*, *Stilbospora*, *Didymosporium*, *Melanconium*.

Ordo III. Sporodesmiei. *Conoplea*, *Phragmotrichum*, *Sporidesmium*, *Aregma*, *Xenodochus*, *Torula*, *Spilocaea*.

Ordo IV. Hypodermii s. Entophyti. *Gymnosporangium*, *Podisoma*, *Puccinia*, *Epitea*, *Aecidium*, *Uredo*, *Ustilago*.

Fries certainly had not a very great opinion of the Hypodermii. The characters he gives to the order are "Vegetatio propria nulla. Sporidia ex anamorphosi telae cellulosae *plantarum vivarum* orta; sub earum epidermide enata et per hanc erumpentia." They are *fungi inferioris ordinis.*

The influence of Fries was such that his lead was followed even in the classification of a group which he little understood and apparently rather despised. In this country Berkeley used the classification in the section he wrote of Smith's English Flora, 1836. He says, however: "I cannot adopt the character of Fries, which begins 'no proper vegetation, *sporidia* arising from an anamorphosis of the cells of living vegetables.' If this were really the case, however interesting in a physiological point of view, these productions ought to be excluded entirely from the list of Fungi on the same principle by which the exclusion of *Erineum* is justified."

Corda (1842) divided the Fungi up as Fries had done but the group Myelomycetes replaced the Gasteromycetes. He subdivided his larger groups into families. The Caeomaceae and the Phragmidiaceae were included in the Coniomycetes. The Aecidiaceae, however, were placed in the Myelomycetes amongst Mucoroideae, Gasteromycetes, Tuberaceae, Pyrenomycetes, Fungi Imperfecti, &c.

Berkeley (Introduction to Cryptogamic Botany 1857), had as two of the divisions the Coniomycetes, Caeomacei of Corda, and Pucciniae. In Outlines of British Fungology, 1860, his divisions were Pucciniaei and Aecidiacei.

Cooke, who sat at the feet of Berkeley and inherited all the latter's conservatism, combined these two classifications in his Handbook of British Fungi 1871. Uredineae, still included with the Sphaeronemei and Melanconiae in the Coniomycetes, are divided into Pucciniaei, Caeomacei and Aecidiacei. Even at this date *Tilletia*, *Ustilago* and *Cystopus* were included in the Caeomacei.

Greville's Flora Edinensis was published in the year 1824. His classification of fungi is somewhat strange. There are three divisions, Fungi Link, Grev., Gastromyci Link, Grev. and Byssoideae Grev. In the Gastromyci, Division II. is composed of

the Uredineae, consisting of *Puccinia* (29 species), *Uredo* (45 species) and *Aecidium* (20 species). The descriptions are accompanied by very valuable notes. I have searched through the works of Link but his Gastromyci group is, in all cases, different from Greville's, which latter contains amongst other genera, *Tremella*, *Stilbum*, *Pilobolus*, *Erysiphe*, together with the Myxomycetes.

Link's best known classification is that contained in the fourth edition of Linné's, Species Plantarum 1824.

I. Hyphomycetes.

II. Gymnomycetes.
- Series 1. *Caeoma*, *Puccinia*, *Triphragmium*, *Phragmidium* and several other genera such as *Melanconium* and *Fusidium*.
- Series 2. *Fusarium*, *Isaria*, *Ceratium*, &c.
- Series 3. *Podisoma*, *Gymnosporangium* with *Sporidesmium*, *Coryneum*, &c.

III. Gasteromycetes.

IV. Sarcomycetes.

In this work *Triphragmium* and *Phragmidium* were diagnosed, the genus *Uromyces* having already been founded by Link (1816).

Brongniart (1824) attempted a natural classification of the fungi. He gives five families: Uredineae, Mucedineae, Lycoperdaceae, Champignons and the Hypoxyleae. The Uredineae (which are more or less the equivalents of the Coniomycetes) are divided into four tribes, Urédinées vraies, Fusidiées, Bactridiées and Stilbosporées. The grouping of the true Uredineae together was an advance on many of the contemporary classifications, but the inclusion of the other tribes in the Uredineae made for great confusion.

Léveillé (1839) wrote a paper on the development of the Uredineae. He divided the group into three families. 1. Aecidineae: *Roestelia*, *Aecidium*, *Peridermium*, *Endophyllum*. 2. Uredineae: *Phragmidium*, *Triphragmium*, *Puccinia*, *Uredo*, *Gymnosporangium*, "auxquels on peut joindre sans inconvénient" *Coryneum*, *Exosporium*, *Sporidesmium*. 3. Ustilagineae: *Ustilago*, *Sporisorium* and perhaps *Sepedonium* and *Testicularia*. These families are "trop distinctes" he said to form a single one under the Uredineae or entophytes. They cannot be confounded since in the first the spores are enclosed in "receptacles propres" which open in different ways: in the second the spores, or better still sporangia, are free and fixed on a stroma which is more or less developed, while in the third the spores have neither receptacle nor stroma but coexist with

byssoid filaments of which the mutual relation is not yet known. The chief fault of this attempt at classification was that many genera foreign to the group were added to Brongniart's "Urédinées vraies."

In 1847 Léveillé had another attempt at classifying the rusts. He states that these fungi are named chiefly from their hosts—a statement which is not surprising. Therefore he holds that the same fungus on different hosts has different names and different fungi on the same host the same name. He considers, with what might be regarded as optimism, that his system would enable one to name the fungus when isolated from the plant which gives it support. He divides the group into 1. Uredineae without cystidia: *Uromyces*, *Pileolaria*, *Cystopus*, *Uredo*, *Polycystis*, *Tilletia*, *Microbotryum*, *Ustilago*, *Thecaphora*, *Coleosporium*. 2. Uredineae with cystidia: *Lecythea*, *Physonema*, *Podosporium*. 3. Doubtful Uredineae: *Protomyces*, *Spilocaea*, *Melampsora*. It will be noticed that the Ustilagineae find their way back to the Uredineae and that *Melampsora* loses its place. It is not regarded as having true spores. Léveillé's conception of many of the genera was remarkable and in the thirty-six species which he gives of *Uromyces* he includes at least three other well-known genera.

It is to Tulasne that we owe the clearing up of ideas on the group in classification as in morphology. The classification given by Tulasne in his second memoir (1854) is as follows:—

I. Albuginei (candidi s. melini, heterospori). *Cystopus*.
II. Aecidinei (peridiati, homoeospori). *Caeoma*, *Aecidium*, *Roestelia*, *Peridermium*.
III. Melampsorei (solidi, pulvinati, biformes). *Melampsora*, *Coleosporium*.
IV. Phragmidiacei (pulverulenti, biformes, infuscati; ordinis centrum). *Phragmidium*, *Triphragmium*, *Puccinia*, *Uromyces*, *Pileolaria*.
V. Pucciniei (carnosi, ligulati v. tremelliformes, nudi et fructibus uniformes; ordinis magnates). *Podisoma*, *Gymnosporangium*.
VI. Cronartei (peridiati, biformes, ligulati, omnium fortassis prae structura nobilissimi). *Cronartium*.

This classification is the basis of all the modern systems. The Ustilagineae are removed from the group. The Albuginei are placed in the group with some doubt. Tulasne had not been able to confirm Prévost's account of the formation of zoospores in *Cystopus*, the confirmation of which came later from de Bary. A point of interest is that the genus *Puccinia* is included in the Phragmidiacei, while the Pucciniei consists of *Podisoma* and *Gymnosporangium*. The inclusion of the group

Aecidinei was justifiable in that it was not then known that *Aecidium*, *Peridermium*, &c., were only stages in the life history of other fungi. This was first shown to be the case by de Bary (1863) working with the autoecious eu-form *Uromyces Fabae*. He germinated teleutospores in artificial media and inoculated bean plants with the sporidia obtained. After nine days spermogonia appeared and aecidia shortly afterwards. About a month after inoculation teleutospores and uredospores were formed. It was certain that these were produced by the same mycelium as the aecidia and spermogonia. The next step taken by de Bary was to prove that the aecidia and spermogonia could be produced on one plant, whereas the uredospores and teleutospores were borne on another. This work on heteroecism began with *Puccinia graminis* in 1865. We have seen how various observers had fumbled about with the idea, but it remained for de Bary to scientifically prove that such a remarkable phenomenon existed. By inoculating barberry leaves with sporidia produced by germinating teleutospores he obtained aecidia and spermogonia. Then when aecidiospores are placed on wheat plants, uredospores and afterwards teleutospores were produced. The work of de Bary soon bore fruit, but many mycologists who totally failed to apprehend the significance of cultural methods criticised the doctrine rather freely. All cultural experiments were not of course successful. The correct conditions for infection were not realised, and modern cultural work on biological species points out another factor which must certainly have caused negative results. Many mycologists seem to think that the fact that farmers had thought there was some connection between the barberry and the wheat mildew was an essential part of the proof of heteroecism. In this country Cooke strongly opposed the idea, but Plowright gave it great support and conducted numerous experiments. W. G. Smith could say in 1884 "Men of science of the present day do not generally try to support their views by quoting what other observers thought one or two hundred years ago, particularly when those observers were not specialists. Old observers were doubtless right in many of their ideas, but no support is given to modern views by quoting the opinions of old authors who were but poorly acquainted with their subject. . . . . Some rustics believe that mushrooms spring from salt, because 'experience has taught' the practical farmer that a dressing of salt over a non-productive pasture will generally cause a good crop of mushrooms to appear. The result in this instance, however unvarying, does not prove genetic relationship," and so on. Whatever might be said of our older British mycologists it cannot be affirmed that their style of writing lacked vigour.

Schroeter in 1879 suggested dividing each genus of the Uredineae into sub-genera or forms depending upon the number of spore forms present in its life cycle. Thus using the initial letters to represent the spores, those forms with S, A, U, T are *eu*-forms, S, A, T-opsis, S, U, T, *Brachy*- U, T, *Hemi*-, T, *Micro*- or *Lepto*- (e.g. Eupuccinia, Pucciniopsis, &c.) the first four teleutospores requiring a period of rest before germinating, while in the last case the teleutospores germinate at once. This convenient classification has been adopted in most systematic works.

Winter in Rabenhorst's Cryptogamic Flora (1884) uses this division of the genera and was the first to apply the facts obtained by cultural experiments to relate up the various spore forms in the life cycle of each species. He does not arrange the genera in families, however, but merely lists them. Plowright in his Monograph (1889) followed this method but his sequence of genera is somewhat different.

Schroeter (Cohn's Kryptogamen Flora von Schlesien 1885) made a forward step in dividing the group. His classification is as follows:—

I. Pucciniei. *Uromyces, Puccinia.*

II. Phragmidiei. *Trachyspora, Triphragmium, Phragmidium.*

III. Endophyllei. *Endophyllum.*

IV. Gymnosporangiei. *Gymnosporangium.*

V. Melampsorei. *Melampsora (Pucciniastrum, Thecospora), Melampsorella, Calyptospora, Coleosporium, Chrysomyxa, Cronartium.*

Appendix. *Uredo, Caeoma, Aecidium.*

This classification was followed by von Tavel in his Morphologie der Pilze 1892. In 1896 appeared Dietel's first classification of the Uredinales in Engler's Pflanzenfamilien. They are classed with the Auriculariales in the Aurictilariineae. The divisions here are I. Endophyllaceae, II. Schizosporaceae, III. Melampsoraceae, a. Chrysomyxeae, b. Cronartieae, c. Coleosporieae, d. Melampsoreae, IV. Pucciniaceae. In the " Nachtrag " to the volume (1900) he rearranged his families and this latter classification is the one now usually followed. I. Melampsoraceae, II. Coleosporiaceae, III. Cronartiaceae, IV. Pucciniaceae. The positions of the second and third families can be seen by glancing at the first system. The Endophyllaceae, Schizosporaceae (which include no British representatives) and the Chrysomyxeae are placed in the Cronartiaceae. Fischer (Die Uredineen der Schweiz, 1904) adopts this classification but his Pucciniaceae has three subfamilies, Puccinieae, Gymnosporangieae and Phragmidieae. It is also followed by Hariot, (Les Urédinées 1908) and Trotter (Flora Italia Cryptogamia, 1908).

In the key to the genera given below the modifications of the last named with regard to subfamilies have been adopted.

In Saccardo's Sylloge Fungorum (1888) De Toni follows Saccardo's well-known method of arranging genera in different spore groups. This grouping, which is very useful in the case of the Fungi Imperfecti, is strikingly artificial when applied to the Uredineae. As the work is supposed to give descriptions of all fungi which have been published, the different spore forms are kept distinct. We even find descriptions of two species of *Aecidiolum*. The four large divisions of Saccardo are utilised I. Amerosporae, teleutospores continuous, unilocular: *Uromyces*, ? *Hemileia*, *Melampsora*, *Melampsorella*, *Cronartium*. II. Didymosporae, spores one-septate or two-celled: *Puccinia*, *Uropyxis*, *Gymnosporangium*. III. Phragmosporae, spores many septate, i.e., three to many-celled: *Phragmidium*, *Xenodochus*, *Coleosporium*, *Chrysomyxa*, *Pucciniastrum*, *Thecopsora*, *Calyptospora*, *Endophyllum*, *Milesia*. IV. Dictyosporae, spores septate in various directions: *Triphragmium*, *Aecidiolum*, *Aecidium*, *Roestelia*, *Peridermium*, *Uredo* (*Caeoma*). That this classification was realised by the author himself to be artificial seems to be shown by the fact that an additional key by Schroeter is given which has a much more natural appearance.

Other classifications that have been proposed are those of de Bary, van Tieghem, Maire and Arthur. De Bary (1884) divided the Uredineae into aecidia-forming Uredineae and tremelloid Uredineae, to which latter the Leptopuccinieae and Leptochrysomyxa belong, and possibly the Micropuccineae. Van Tieghem published two different classifications. The one (1891), constructed before his work on the homologies of the promycelium, divided the Uredineae into three families. 1. Puccinieae, with teleutospores non gelatinous, free: *Uromyces*, *Puccinia*, *Triphragmium*, *Phragmidium*, *Endophyllum*. 2. Gymnosporangieae, teleutospores gelatinous, confluent, with tardive germination: *Melampsora*, *Thecopsora*, *Calyptospora*, *Gymnosporangium*. 3. Coleosporieae, teleutospores gelatinous, confluent, germinating immediately: *Cronartium*, *Chrysomyxa*, *Coleosporium*. His second classification (1898) was much influenced by his having realised the homology between the promycelium in the Uredineae and the basidium in the Basidiomycetes. The Uredineae (now the Pucciniaceae) are in this work divided into two families, the Coleosporieae for those genera where the teleutospore becomes itself a promycelium, and the Puccinieae for those genera in which the teleutospore sends forth a promycelium.

Maire (1902) in his "Recherches cytologiques et taxo-

nomiques sur les Basidiomycètes," divided his 'Protobasidiomycètes Stichobasidiés' into Uredineae and Auricularineae. The former were subdivided into Pucciniaceae, (Puccinieae, Melampsoreae), Coleosporiaceae, Zaghouaniaceae, Endophyllaceae. The Zaghouaniaceae contains only the one genus Zaghouania, the teleutospore of which differs from that of the Pucciniaceae " par son caractère kystique peu accentué et sa germination semi-interne."

None of these latter classifications have been used by systematists.

With regard to the delimitation of genera it has been often pointed out that too much importance is being placed upon the teleutospore, and more stress should be laid upon the cycle of development. Arthur (1906) has applied this principle to the classification of the group. He makes the aecidium of greater importance than the teleutospore. He divides each tribe into four groups according to the spore stages present, each genus possessing only species which have the same types of fructification. The parasitical relation between fungus and host is also considered. Unfortunately Arthur makes many remarkable changes in the nomenclature of the genera. *Gymnosporangium* figures as *Aecidium*, *Melampsora* as *Uredo*, and so on; also many of the early ill-defined genera which had fallen out of use are revived. When a system which professes to be a natural one appears, it is annoying to find that it has such a forbidding aspect, the author having undertaken to revise both terminology and nomenclature. Arthur has worked out his system to its logical conclusions in the North American Flora which is at present appearing.

In drawing up the following key to the genera and the list of species of British Uredineae the writer is particularly indebted to the works of Plowright, Dietel, Fischer, Hariot and Sydow.* The letters S, A, U, T, following the names of the species indicate whether spermogonia, aecidia, uredospores and teleutospores are known or not in that species. Heteroecious species are italicised. An asterisk indicates that biological forms are known, or that the species as given has been split up into many morphologically very similar. The species in square brackets are not yet definitely recorded for this country, although their presence is practically certain. In the genus *Melampsora*, the species on willows and poplars, (*M. farinosa*, *M. mixta*, *M. aecidiodes*, *M. Populina*, *M. vitellina*, *M. Tremulae*, and *M. epitea*), have been divided into a number of species principally by Klebahn, working with inoculation methods. Most, if not all, of these species undoubtedly occur in this country, although few of them have yet been recorded.

The nomenclature followed is that of the standard works on

* While the present paper was in the press, Mr. W. B. Grove most kindly

the group and, only in those cases where there is disagreement has the question been entered into as to which names must be accepted according to the International Rules. These rules, as far as they relate to fungi, are as follows:—

"Art. 19. Botanical nomenclature begins for—

e. Fungi: Uredinales, Ustilaginales and Gastromycetes 1801 (Persoon, Synopsis methodica Fungorum).

f. Fungi caeteri. 1821-32 (Fries, Systema mycologicum)."

"Art. 49 bis. Among Fungi with a pleomorphic life-cycle the different successive states of the same species (anamorphoses, status) can bear only one generic and specific name (binomial) that is the earliest which has been given, starting from Fries, Systema, or Persoon, Synopsis, to the state containing the form which it has been agreed to call the perfect form, provided that the name is otherwise in conformity with the rules. The perfect state is that which ends in the ascus stage in the Ascomycetes, in the basidium in the Basidiomycetes, in the teleutospore or its equivalent in the Uredinales and in the spore in the Ustilaginales.

"Generic and specific names given to other states have only a temporary value. They cannot replace a generic name already existing and applying to one or more species, any one of which contains the 'perfect' form.

"The nomenclature of Fungi which have not a pleomorphic life cycle follows the ordinary rules."

BRITISH UREDINALES.

I. PUCCINIACEAE.

Teleutospores pedicellate (stalk sometimes short or deciduous), uni- or pluricellular, in pulverulent, compact or gelatinous sori; promycelium septate, segments with sporidia-bearing sterigmata; sporidia ovoid or reniform, generally hyaline. Uredospores solitary, not catenulate, pedicellate. Aecidium with, or without pseudoperidium.

(1) Puccinieae.

Teleutospores uni- or bi-cellular, in pulverulent or compact sori. Aecidium usually provided with a pseudoperidium.

Teleutospores mostly one-celled.

Uredospores smooth on one surface, warted on other .... *Hemileia.*

Uredospores echinulate, warted or smooth over whole surface .... *Uromyces.*

Teleutospores mostly two-celled .... *Puccinia.*

(2) GYMNOSPORANGIEAE.

Teleutospores usually bicellular, with long pedicels embedded in gelatinous masses. Aecidium with pseudoperidium .... *Gymnosporangium.*

(3) PHRAGMIDIEAE.

Teleutospores bi- or pluri-cellular in pulverulent sori. Aecidium *(Caeoma)* without pseudoperidium.

Teleutospores mostly three to more celled, cells in a row .... *Phragmidium.*

Teleutospores three-celled, cells arranged in form of triangle .... *Triphragmium.*

II. CRONARTIACEAE.

Teleutospores sessile, unicellular, arranged in series (simulating pluricellular spores) separating from one another, or arranged in cylindrical, lenticular or wart-like sori. Promycelia as above; sporidia subglobose, small, hyaline. Aecidium with pseudoperidium.

Teleutosorus without pseudoperidium.

Teleutospores composed of series of superimposed cells, forming flat or slightly elevated waxy crusts .... *Chrysomyxa.*

Teleutospores compacted into a cylindrical body *Cronartium.*

Teleutosorus with pseudoperidium, resembling an aecidium .... *Endophyllum.*

III. COLEOSPORIACEAE.

Teleutospores sessile or with lateral pedicel, dividing into four superposed cells, each with a simple sterigma bearing a large sporidium (about 20μ diam.). Promycelium usually internal. Teleutospores confluent in flat waxy masses of one or two layers. Aecidia provided with variously constituted pseudoperidia.

(1) ZAGHOUANIEAE.

Teleutospores with lateral pedicel. Promycelium internal only at the beginning ....*Zaghouania.*

(2) COLEOSPORIEAE.

Teleutospores sessile, promycelium internal.

Teleutospores with short sterigmata; sporidia fusiform; uredospores scattered; aecidium with cup-shaped pseudoperidium ...... *Ochropsora.*

Teleutospores with long sterigmata; sporidia elliptical; uredospores in chains; aecidium with inflated torn pseudoperidium ...... *Coleosporium.*

IV. MELAMPSORACEAE.

Teleutospores sessile, one- or many-celled, loose in tissue of host plant or united in a flat layer under the epidermis: Ger-

mination as in I.; sporidia globose, small, about 10μ diam. Uredospores single. Aecidium and uredosorus with or without pseudoperidium.

Teleutospores vertically septate.

Teleutospores forming a crust, subepidermal or in the epidermal cells.

Teleutospores with brown membrane; aecidium and uredosorus provided with pseudoperidium *Pucciniastrum.*

Teleutospores with hyaline membrane; uredosorus with or without pseudoperidium; no aecidium *Hyalopsora.*

Teleutospores dispersed in the mesophyll: uredosorus with pseudoperidium .... *Uredinopsis.*

Teleutospores not septate.

Uredospores surrounded by paraphyses which are thickened at the summit: uredosorus and aecidium (Caeoma) without pseudoperidium *Melampsora.*

Uredospores without paraphyses: uredosorus and aecidium with pseudoperidium.

Teleutospores with brown membrane *Melampsoridium.*

Teleutospores with hyaline membrane *Melampsorella.*

UROMYCES Link.
- Ficariae (Schum.) Lév. U., T.
- *caryophyllinus* (Schr.) Schroet., A., U., T.
- Behenis (DC.) Unger, S., A., T.
- sparsus (K. et Sch.) Lév., S., A., U., T.
- Geranii (DC.) Otth. S., A., U., T.
- Kabatianus Bubak, S., A., U., T.
- Anthyllidis (Grev.) Schroet., U., T.
- Ervi (Wallr.) Westend., A., U., T.
- *Loti* Blytt., S., A., U., T.
- **striatus* Schroet., S., A., U., T.
- Orobi (Pers.) Plow., S., A., U., T.
- appendiculatus (Pers.) Link, S., A., U., T.
- **Pisi* (Pers.) Schroet., S., A., U., T.
- Phaseoli (Pers.) Wint., S., A., U., T.
- Trifolii (Hedw.) Lév., S., A., U., T.
- Trifolii-repentis (Cast.) Lindroth, S., A., U., T.
- flectens Lagerh., T.
- *Fabae (Pers.) de Bary, S., A., U., T.
- Alchemillae (Pers.) Lév., U., T.
- Valerianae (Schum.) Fuck., S., A., U., T.
- Scrophulariae (DC.) B. et Br., S., A., T.
- Limonii (DC.) Lév., S., A., U., T.
- Armeriae (Schlecht.) Lév., S., A., U., T.
- Betae (Pers.) Tul., S. A., U., T.

Salicorniae (DC.) de Bary, A., U., T.
Chenopodii (Duby) Schroet., S., A., U., T.
Polygoni (Pers.) Fuck., S., A., U., T.
Rumicis (Schum.) Wint., U., T.
Acetosae Schroet., S., A., U., T.
*scutellatus (Schrank) Lév., S., U., T.
tuberculatus (Fuck.) Magn. S., A., U., T.
ambiguus (DC.) Lév., U., T.
Urticae Cooke, T.
Ornithogali Lév., T.
Gageae Beck., T.
Colchici Mass., T.
Lilii (Link) Fuck., S., A., T.
Scillarum (Grev.) Wint., T.
Alliorum (DC.) Cooke, T.
Junci (Desm.) Wint., S., A., U., T.
**lineolatus* (Desm.) Schroet. (= U. Scirpi (Cast.)), S., A., U., T.
maritimae Plow., S., A., U., T.
**Dactylidis* Otth, S., A., U., T. (= Aecid. Ranuculacearum DC. pp.).
**Poae* Rabenh., A., U., T. (= Aecid. Ranuculacearum DC. pp.).

PUCCINIA Pers.
fusca (Relh.) Wint., S., T.
Calthae Link, S., A., U., T.
Zopfii Wint., S., A., U., T.
Thalictri Chev., T.
*Violae (Schum.) DC., S., A., U., T.
aegra Grove, A., U., T.
Fergussoni B. et Br., T.
Arenariae (Schum.) Wint., T.
Silenes Schroet., S., A., U., T.
Spergulae DC., T.
Malvacearum Mont., T.
argentata (Schultz) Wint., S., A., U., T.
**Pruni-spinosae* Pers., S., A., U., T.
pulverulenta Grev. (= Epilobii-tetragoni (DC.) Wint.), S., A., U., T.
*Epilobii DC., T.
Circaeae Pers., T.
Umbilici Guép., T.
Rhodiolae B. et Br., T.
*Ribis DC., T.
*Saxifragae Schlecht., T.
Pazschkei Diet., T.
Chrysosplenii Grev., T.
Aegopodii (Schum.) Mart., T.
*Angelicae (Schum.) Fuck., S., U., T.
Apii Desm., S., A., U., T.
Bulbo-castani (Cum.) Fuck., A., T.
Bupleuri Rud., S., A., U., T.
*Chaerophylli Purt., S., A., U., T.
Cicutae Lasch, S., A., U., T.
Conii (Str.) Fuck., U., T.
tumida Grev. (= P. Bunii (DC.) Wint.), T.
Heraclei Grev., S., A., U., T.
Hydrocotyles (Link) Cooke, A., U., T.
Aethusae Mart., S., U., T.
*bullata (Pers.) Schroet., S., U., T.
Pimpinellae (Str.) Mart., S., A., U., T.
Saniculae Grev., S., A., U., T.
Smyrnii Biv., S., A., T.
albescens Grev., S., A., U., T.
Adoxae Hedw. fil., T.
*punctata Link (= P. Galii Schw.), S., A., U., T.
Asperulae-odoratae Wurth., A., U., T.
Celakovskiana Bubak, S., U., T.
*Valantiae Pers., T.
*Millefolii Fuck., T.

Absinthii DC., U., T.
Tripolii Wallr., T. (=P. Asteris Duby).
Carduorum Jacky, U., T.
Cardui-pycnocephali Syd., U., T.
Carlinae Jacky, U., T.
Cyani (Schleich.) Pass., U., T.
*Centaureae Mart., S., U., T.
Cichorii (DC.) Bell., U., T.
Chrysanthemi Roze, U., T. (=Uredo Chrysanthemi Roze.).
obtegens (Link) Tul. (=P. suaveolens Rost.), S., U., T.
Cirsii Lasch, U., T.
Cnici-oleracei Pers., T. (=P. Cardui Plow.).
Andersoni B. et Br.
major Diet., S., A., U., T.
Crepidis Schroet., S., A., U., T.
*Hieracii (Schum.) Mart., U., T.
Hypochaeridis Oud., U., T.
Chondrillae Corda, A., U., T.
Lampsanae (Schultz.) Fuck., S., A., U., T.
Bardanae Corda, U., T.
Leontodontis Jacky, U., T.
Leucanthemi Pass., T.
Senecionis Libert, A., T.
glomerata Grev., T.
tinctoriicola Magn., U., T.
Virgaureae (DC.) Libert, T.
Sonchi Roberge, U., T.
Tanaceti DC., U., T.
variabilis Grev., S., A., U., T.
Taraxaci Plow., U., T.
Tragopogi (Pers.) Corda, S., A., U., T.
Campanulae Carm., T.
Primulae (DC.) Duby., A., U., T.
Soldanellae (DC.) Fuck., S., A., U., T.
Vincae (DC.) Berk., S., U., T.
Gentianae (Str.) Mart., S., A., U., T.
Convolvuli (Pers.) Cast., A., U., T.
Veronicae Schroet., T.
Veronicarum DC., T.
Betonicae (A. et S.) DC., T.
Glechomatis DC., T.
*Menthae Pers., S., A., U., T.
*annularis (Str.) Schlecht., T.
caulincola Schneid., T.
Oxyriae Fuck., U., T.
Polygoni A. & S., S., A., U., T.
Polygoni-amphibii Pers., S., A., U., T.
Polygoni-vivipari, Karst., A., U., T.
**Bistortae* (Str.) DC., S., A., U., T.
Acetosae (Schum.) Koern., U., T.
Thesii (Desv.) Chaillet, S., A., U., T.
Buxi DC., T.
asarina Kunze, T.
Porri (Sow.) Wint., A., U., T.
Asparagi DC., S., A., U., T.
*Liliacearum Duby, S., A., T.
Iridis (DC.) Wallr., U., T. (=Uredo Iridis (Thüm.) Plow.).
Schroeteri Passer., T.
oblongata (Link) Wint., U., T.
obscura Schroet., A., U., T.
**Caricis* (Schum.) Rebent, S., A., U., T.
Pringsheimiana Kleb., S., A., U., T.
Magnusii Kleb., S., A., U., T.
dioicae Magn. S., A., U., T.
sylvatica Schroet, S., A., U., T.
Schoeleriana Plow. et Magn., S., A., U., T.
arenariicola Plow., A., U., T.

extensicola Plow., A., U., T.
paludosa Plow., S, A., U., T.
uliginosa Juel., A., U., T. (= Aecidium Parnassiae Grev.)
Scirpi DC., S., A., U., T.
**graminis* Pers., S., A., U., T.
**coronata* Corda., S., A., U., T.
**Lolii* Niels (= P. coronifera Kleb.) S., A., U., T.
**glumarum* (Sch.) Erikss. et Henn., U., T.
**dispersa* Erikss. et Henn., A., U., T.
agropyrina Erikss., U., T.
holcina Erikss., U., T.
Triseti Erikss., U., T.
triticina Erikss., U., T.
Bromina Erikss., S., A., U., T.
Agrostidis Plow., S., A., U., T.
perplexans Plow., A., U., T.
*Anthoxanthi Fuck., U., T.
Arrhenatheri (Kleb.) Erikss., S., A., U., T.
Baryi (B. et Br.) Wint., U., T.
**Festucae* Plow., S., A., U., T.
simplex (Koern.) Erikss. et Henn., U., T.
paliformis Fuck., T.
**Moliniae* Tul., A., U., T.
**sessilis* Schneid., S., A., U., T.
Orchidearum-Phalaridis Kleb., S., A., U., T.
Winteriana Magn. (= P. Allii-Phalaridis Kleb.) S., A., U., T.
Phalaridis Plow., S., A., U., T.
Phlei-pratensis Erikss. et Henn., U., T.
Magnusiana Koern., A., U., T.
Phragmitis (Schum.) Koern., A., U., T.
Trailii Plow., A., U., T.
Poarum Niels., S., A., U., T.
Agropyri Ell. et. Everh., A., U., T. (= Aecidium Clematidis DC.).
persistens Plow., S., A., U., T.

HEMILEIA B. et Br.
Phaji Syd., U., T.
Oncidii Griff. et Maubl., U., T.
americana Mass., U., T.

GYMNOSPORANGIUM Hedw. fil.
clavariaeforme (Jacq.) Reess, S., A., T.
Juniperi Lk., S., A., T.
Sabinae (Dick.) Wint., S., A., T.
confusum Plow., S., A., T.

TRIPHRAGMIUM Link.
Ulmariae (Schum.) Link., S, A., U., T.
Filipendulae (Lasch) Pass., A., U., T.

PHRAGMIDIUM (including Xenodochus) Link.
Potentillae (Pers.) Wint., S., A., U., T.
Fragariastri (DC.) Schroet., S., A., U., T.
Sanguisorbae (DC.) Schroet., S., A., U., T.
*subcorticium (Schrank) Wint., S., A., U., T.
tuberculatum Müll., S., A., U., T.
fusiforme Schroet. (= P. Rosae-alpinae (DC.) Wint.), A., U., T.
albidum (Kühn.) Ludw. (= Chrysomyxa albida Kühn, Kühneola Magn.), U., T.
Rubi (Pers.) Wint., A., U., T.
violaceum (Schultz) Wint., S., A., U., T.
Rubi-Idaei (Pers.) Karst., S., A., U., T.
carbonarium (Schlecht.) Wint. (= Xenodochus carbonarius Schlecht.), A., T.

Tormentillae Fuck., A., T. (= Xenodochus Tormentillae (Fuck.) Magn.).
?curtus (Cooke) (= Xenodochus curtus Cooke), T.

COLEOSPORIUM Lév.
Cacaliae (DC.) Wagner (= Peridermium Magnusianum Fisch., P. Magnusii Wagn.), S., A., U., T.
**Campanulae* (Pers.) Lév. (= Peridermium Rostrupi Fisch., P., oblongo-sporum Kleb., P. Kosmahlii Wagn.), S., A., U., T.
Euphrasiae (Schum.) Wint. (= Peridermium Stahlii Kleb.), S., A., U., T.
Melampyri (Rebent) Kleb. (= Peridermium Soraueri Kleb.), S., A., U., T.
Petasitis de Bary (= Peridermium Boudieri Fisch., P. Dietelii Wagn.), S., A., U., T.
**Senecionis* (Pers.) Fr. (= Peridermium oblongosporum Kleb., P. Pini Chev., P. acicolum Link, P. Pini-acicola Hartig), S., A., U., T.
Sonchi-arvensis (Pers.) Lév. (= Peridermium Fischeri Kleb.), S., A., U., T.
Tussilaginis (Pers.) Kleb. (= Peridermium Plowrightii Kleb.), S., A., U., T.

OCHROPSORA Diet.
[*Sorbi* (Oud.) Diet.] (= Aecidium leucospermum DC., Endophyllum leucospermum (DC.) Soppitt), S., A., U., T.

ZAGHOUANIA Pat.
[Phillyreae Pat.] (= Uredo Phillyreae Cooke, Aecidium Phillyreae DC.), A., U., T.

CRONARTIUM Fries.
asclepiadeum (Willd.) Fr. (= C. flaccidum (A. et S.) Wint.), (= Peridermium Cornui Kleb.), S., A., U., T.
ribicolum Dietr. (= Peridermium Strobi Kleb.), S., A., U., T.

CHRYSOMYXA Unger.
Empetri (Pers.) Rostr., U., T.
Pyrolae (DC.) Rostr., U., T.

PUCCINIASTRUM Otth. (including Thecopsora Magn. and Calyptospora Kühn).
Circaeae (Schum.) Schroet., U., T.
Agrimoniae (DC.) Tranzschel., U., T.
Epilobii (Pers.) Otth, S., A., U., T.
Galii (Link) Fisch. (Thecopsora), U., T.
Padi (K. et Sch.) Diet. (Thecopsora), A., U., T. (= Aecidium strobilinum A. et S.).
Vacciniorum (Link) Diet. (Thecopsora), U., T.
Goeppertianum (Kühn). Kleb. (Calyptospora), A., T. (= Aec. columnare A. et S.).

HYALOPSORA Magn.
[Adianti-Capilli-Veneris (DC.) Syd.], U., T. (= Uredo Polypodii Pers. pp.)
Polypodii (Pers.) Magn., A., U., T. (= Uredo Polypodii Pers. pp.).
Aspidiotus (Peck) Magn., A., U., T.

UREDINOPSIS Magn.
Scolopendrii (Fuck.) Rostr. (= Uredo (Milesia) Scolopendrii Fuck. pp.), U., T.
[filicina (Niessl.) Magn.].

MELAMPSORA Cast.
*Helioscopiae (Pers.) Cast., S., A., U., T.

*Hypericorum (DC.) Schroet., A., T.
Lini (Pers.) Desm., S., A., U., T.
Amygdalinae Kleb., S., A., U., T.
arctica Rostr., U., T.
Saxifragarum (DC.) Schroet. S., A., U., T. (= M. vernalis Niessl.).
[*Larici-pentandrae* Kleb.], A., U., T.
[*Allii-Salicis-albae* Kleb.] (= Caeoma alliorum Link pp.), S., A., U., T.
[*Allii-fragilis* Kleb.] (= Caeoma alliorum Link pp.), S., A., U., T.
[*Galanthi-fragilis* Kleb.] (= Caeoma Galanthi Unger), S., A., U., T.
Larici-Caprearum Kleb., A., U., T.
**Larici-Epitea* Kleb., A., U., T.
Orchidi-repentis (Plow.) Kleb. (= Caeoma Orchidis (Mart.) Wint.), S., A., U., T.
[*Euonymi-Caprearum* Kleb.] (= Caeoma Euonymi Mart.), S., A., U., T.
[*alpina* Juel] (= Caeoma Saxifragae Strauss pp.), S., A., U., T.
[*Ribesii-purpureae* Kleb.] (= Caeoma confluens (Pers.) Schroet. pp.), S., A., U., T.
[*Ribesii-auritae* Kleb.] S., A., U., T.
[*Ribesii-viminalis* Kleb.] (= Caeoma confluens (Pers.) Schroet. pp.), S., A., U., T.
[*Larici-Tremulae* Kleb.] (= Caeoma Laricis Hartig pp.), A., U., T.
[*pinitorqua* Rostr.] (= Caeoma pinitorquum Braun.), A., U., T.
[*Magnusiana* Wagner] (= Caeoma Chelidonii Schw., C. Fumariae Link), S., A., U., T.
Rostrupii Wagn. (= Caeoma Mercurialis (Mart.) Link pp.), S., A., U., T.
[*Larici-populina* Kleb.] (= Caeoma Laricis Hartig pp.), A., U., T.
[*Alii-populina* Kleb.] (= Caeoma alliorum Link pp.), S., A., U., T.

MELAMPSORIDIUM Kleb.
betulinum (Pers.) Kleb., A., U., T.

MELAMPSORELLA Schroet.
Caryophyllacearum (DC.) Schroet. (= M. Cerastii (Pers.)), S., A., U., T.
Symphyti (DC.) Bubak (= Uredo Symphyti DC.), S., A., U., T.
Blechni Syd. (= Uredo (Milesia) Scolopendrii Fuck. pp., Milesina Magn.), U., T.
Dieteliana Syd. (= Uredo Polypodii Pers. pp., Milesina Magn.), U., T.

UREDO Pers.
Quercus Brond. (= Cronartium Quercus (Brond.) Schroet.).
Tropaeoli Desm.
Lynchii (B. et Br.) Plow.
Plantaginis B. et Br.
Pyrolae Grev. (= Pucciniastrum Pyrolae (Gmel.) Diet.

CAEOMA Tul.
Ari-italici Duby.

AECIDIUM Pers.
Ranuculacearum DC. var. Linguae DC.
Hellebori Fisch.
dracontii Schw.
incarceratum B. et Br. (= ? Doassansia Sagittarieae (Fuck.) Fisch.
Poterii Cooke.
pseudo-columnare Kühn.

UPON THE RETENTION OF VITALITY BY DRIED FRUIT-BODIES OF CERTAIN HYMENOMYCETES INCLUDING AN ACCOUNT OF AN EXPERIMENT WITH LIQUID AIR.

By Professor A. H. R. Buller, D.Sc., Ph.D., F.R.S.C.

In 1909 it was shown by the writer* that the fruit-bodies of a considerable number of species of Hymenomycetes which grow on sticks and logs, can be dried up by exposure to the air in rooms without any loss of vitality, and that the vitality of some species, after desiccation has taken place, may be continued for years. When the fruit-bodies are moistened once more by placing wet cotton-wool on their upper surfaces, after a few hours, spore-liberation recommences. A stream† of spores is emitted for several days, and the spores liberated from the revived fruit-bodies are capable of germination. Typical xylophilous genera having fruit-bodies, the vitality of which will resist desiccation, are: Corticium, Stereum, Phlebia, Daedalea, Polystictus, Schizophyllum, and Lenzites. Many species of Marasmius and some species of Collybia, the mycelium of which vegetates in turf or among dead leaves, also have fruit-bodies which retain their vitality when they have been dried.

Further investigations‡ made it clear that the dried fruit-bodies, when exposed to the air, lose their vitality in the course of a few months or years in the same manner as the seeds of Flowering Plants. Thus *Marasmius oreades* recovered on moistening after desiccation for six weeks but not after three months, and *Lenzites betulina* recovered after desiccation for three years but not after five years.

Since the publication of my "Researches on Fungi," I have carried out some further investigations upon the vitality of the fruit-bodies of Hymenomycetes. A short account will here be given of some of the results of the work.

A number of additional species have been tested for the re-

* Buller, "Researches on Fungi," Longmans, Green & Co., London, 1909, pp. 105-111.

† The emission of spores from fruit-bodies can be seen readily by my beam-of-light method. *Ibid.*, pp. 94-101.

‡ Buller, "Researches on Fungi," p. 111.

tention of the vitality of the fruit-bodies in the dried condition. Successful retention was found for *Panus stipticus*, *Claudopus (Pleurotus) nidulans*, *Polyporus brumalis*, *Exidia glandulosa*, *Hirneola Auricula-Judae*, *Calocera cornea*, and the younger fruit-bodies of *Collybia velutipes*.

It is quite certain that the mature fruit-bodies of Coprinus, Bolbitius, Panaeolus, Stropharia, as well as those of a number of other fleshy genera of Agaricineae, will not survive desiccation. However, very young fruit-bodies may behave in an entirely different manner, as is shown by the following observations upon species of the delicate genus Coprinus. At Banbury, England, in the month of August, I found some young and unexpanded fruit-bodies of *Coprinus niveus* coming up on some horse dung in a field. I collected the dung, allowed it to dry by exposing it on a table in a dry room, and subsequently took it to Winnipeg. In the following April, eight months after the material had been dried, it was set in a damp-chamber and moistened. The young fruit-bodies immediately revived and were seen as small snow-white balls about 2 mm. in diameter. On the night of the fourth day after revival, the stipes elongated, the pilei underwent their usual process of autodigestion, and millions of spores were liberated. Similar observations have been made on other species of Coprinus: *C. ephemerus*, *C. bisporigera*,* etc. In these cases the young fruit-bodies, although unexpanded, had their pileus, stipe, and gills differentiated from one another before desiccation took place.

Falck† pointed out that the mycelium of *Coprinus sterquilinus* is still able to continue its development after the horse-dung balls in which it has existed have been kept dry for a year. Observations of my own on a considerable number of species of Coprinus have convinced me that the retention of vitality by the dried mycelium for some months or years is the rule in this genus. The young fruit-bodies of the Coprini, therefore, share their resistance to desiccation with the mycelium from which they spring.

Fruit-bodies of *Daedalea unicolor* can retain their vitality kept in the dark, and exposed to ordinary air at room temperatures, for at least eight years and three months, and those of *Schizophyllum commune* for at least six years and three months. These two species retain their vitality longer than any others which have been tested. In most species, e.g., *Polystictus versicolor*, *Lenzites betulina*, and *Phlebia pileata*, the vitality persists only for two or three years and is lost in less than five.

* A new species having basidia which bear only two spores. *Vide* Buller, The Production and Liberation of Spores in the genus Coprinus. Trans. Brit. Myc. Soc. 1911, p. 350.

† R. Falck, Beiträge zur Biologie der Pflanzen, Bd. viii., 1902, p. 317.

Fruit-bodies of *Daedalea unicolor* which have been kept dry for eight years and three months, and of *Schizophyllum commune* which have been kept dry for six years and three months, revive much more slowly than fruit-bodies only one year old, shed a reduced number of spores, and become putrid relatively sooner. It is evident that their vitality has become very much diminished and that shortly it will be extinguished altogether. Possibly the vitality of dried fruit-bodies does not persist in any species of Hymenomycetes longer than ten years, but only further experiment can settle this question. The following Table contains the experimental results for a few of the species tested:—

LIST OF SOME HYMENOMYCETES WITH FRUIT-BODIES WHICH CAN BECOME DESICCATED WITHOUT LOSING THEIR VITALITY.

Family.	Species.	Recovered after dessication for:	Failed to recover after dessication for:
Thelephoreae	Stereum purpureum	1 year	5 years 3 months
	,, bicolor	1 year 6 months	2 years
Hydneae	Phlebia pileata	2 years 8 months	4 years 4 months
	,, zonata	1 year	3 years 6 months
Polyporeae	Merulius corium	2 years	5 years 3 months
	Daedalea unicolor	8 years 3 months	—
	Polyporus rigens	2 years	6 years 3 months
	Polystictus versicolor	2 years	4 years
	,, hirsutus	3 years	5 years 3 months
Agaricineae	Trogia crispa	4 months	1 year
	Schizophyllum commune	6 years 3 months	—
	Lenzites betulina	3 years	5 years
	Marasmius oreades	6 weeks	3 months

Paul Becquerel* has endeavoured to find out whether or not there may be an entire suspension of vitality in the reproductive bodies of plants. He first found that dried seeds of various kinds such as peas, on being placed in pure and dry nitrogen for a year, did not liberate a trace of carbon dioxide and yet germinated subsequently. He† then showed that grains of Wheat and that seeds of White Mustard and of Lucerne, after having their coats perforated, can be subjected to total desiccation in a vacuum of one five-hundredth of a millimetre pressure of mercury for one year, and that during this period they can be subjected for three weeks to the temperature of liquid air (-190° C.), and for seventy-seven hours to the temperature of liquid hydrogen (-253° C.), and that, nevertheless, when subsequently they are supplied with air and moisture at a suitable temperature, they germinate in a normal manner. Becquerel came to the conclusion that his experiments, along with those of his predecessors, indicate that at least for the seeds upon which he experimented, an interruption of life is not only possible but actual, without there being any indication of a limit to its prolongation.

Paul Becquerel‡ has extended his investigations to the spores of certain Moulds: *Mucor Mucedo*, *M. racemosus*, *Rhizopus niger*, *Sterigmatocystis nigra*, and *Aspergillus glaucus*. The spores were dried slowly, in the presence of caustic baryta, for two weeks at 35° C. The containing tubes were afterwards sealed to a Berlement mercury pump and evacuated as perfectly as possible; they were sealed off after a McLeod gauge had indicated a pressure of less than one thousandth of a millimetre of mercury. The vacuum was maintained for twenty-five months, and during this period the spores were subjected to the temperatures of liquid air and liquid hydrogen for three weeks and seventy-seven hours respectively, as was done with the seeds. When the spores were subsequently placed upon sterilized nutritive media, they soon germinated in a normal manner and a fresh crop of spores was quickly produced.

Mr. A. T. Cameron and I,§ working in conjunction, have endeavoured to find out whether or not the fruit-bodies of xylo-

* Paul Becquerel. "Sur la nature de la vie latente des graines et sur les veritables caractères de la vie," Compt. rend., 1906, T. 143, pp. 1177-9.

† Paul Becquerel "Sur la suspension momentanée de la vie chez certaines graines." Compt. rend., 1909, T. 148, pp. 1052-4.

‡ Paul Becquerel, "Recherches expérimentales sur la vie latente des spores des Mucorinées et des Ascomycètes," Compt. rend., 1910, T. 150, pp. 1437-9.

§ *cf.* Buller and Cameron, "On the Temporary Suspension of Vitality in the Fruit-bodies of Hymenomycetes." Read before the Royal Soc. of Canada, May 1912, now in course of publication in the Trans. Roy. Soc., Canada,

philus Hymenomycetes can have their vitality temporarily suspended,—whether they can successfully retain their vitality under conditions which would seem to prevent all metabolism from being carried on. Following, as far as our apparatus permitted, the methods of Paul Becquerel, we observed that the fruit-bodies of *Schizophyllum commune*, after previous thorough drying by exposure to phosphorus pentoxide *in vacuo*, retain their vitality after being kept for sixteen and a half months in a vacuum at a pressure of not more than one-tenth of a millimetre of mercury, in the dark at room temperatures. We also showed that the fruit-bodies, either when moist or dry, are not killed by several hours exposure to a temperature of -35° C., such as occurs during some of the winter nights in Manitoba. These observations pointed to the conclusion that in their retention of vitality, when dried, exposed to ordinary air or kept *in vacuo*, the fruit-bodies of certain Hymenomycetes resemble the seeds of the Higher Plants and the spores of Moulds. Unfortunately, however, the University of Manitoba does not possess a liquid-air plant, so that we were unable to obtain such low temperatures as those used by Becquerel.

Through the kindness of Professor J. H. Poynting, the writer, in the summer of 1912, was supplied with liquid air in the Physics Department of the University of Birmingham. The following experiment was then carried out. Some *Schizophyllum* fruit-bodies which had been already kept dry in ordinary air for two years and eight months, were placed in glass tubes closed at one end. The tubes were then sealed on to a vacuum apparatus consisting of a charcoal-bulb, a phosphorus-pentoxide tube, and an electric-discharge tube. A preliminary exhaustion was made with a Fleuss pump to about 4 mm. of mercury and then the apparatus was sealed off from the pump. The charcoal-bulb was then immersed in liquid air for twenty-four hours to complete the exhaustion, and during this time the fruit-bodies were drying in the presence of phosphorus pentoxide. At the end of this time the discharge-tube showed green fluorescence, proving that the vacuum was exceedingly high,—at about the X-ray stage. The tubes containing the fruit-bodies were then sealed off, removed, and immersed in liquid air contained in a large Dewar flask. Now, therefore, the fruit-bodies which had been thoroughly dried and placed in a very high vacuum, were subjected to a temperature of -190° C. The tubes were kept immersed in liquid air continuously for three weeks. At the end of this time, they were taken out of the liquid air, allowed to take on the room temperature, and then broken open. The fruit-bodies were taken out of the tubes, placed in a damp chamber with wet cotton wool on their upper surfaces, and left for about twelve hours. They were

then placed on a glass slide with their gills turned downwards. In a few minutes, a well-marked spore-deposit collected on the slide, the white lines of which indicated that all the gills were actively discharging spores. In the course of a few hours, a heavy spore-deposit collected, a conclusive proof that the fruit-bodies had resumed their normal activity.

The above experiment has shown that the fruit-bodies of *Schizophyllum commune*, after having been kept dry and exposed to air for two years and eight months, are able to retain their vitality when subsequently they have been dried *in vacuo* by the phosphorus-pentoxide and charcoal-bulb liquid-air method and subjected to the temperature of liquid air for three weeks.

It is difficult to imagine how any metabolism can go on in a fruit-body which is thoroughly dried, placed in a high vacuum, and subjected for three weeks to a temperature of -190° C. The experiment seems to indicate that here, as in the case of Becquerel's seeds and spores, there must be a temporary suspension of vitality. It is possible to conceive of a clock so constructed that it would stop when the temperature of the surrounding air fell below a certain point, or when it was placed in a vacuum, but which would start again when normal conditions were allowed to supervene. Perhaps the machinery of metabolism in the fruit-bodies ceases to work under the conditions of our experiment, but is uninjured and ready to resume its normal course when allowed to do so by a rise in temperature and access to moisture and air. At present I am unable to think of any valid reason why one should not admit the occurrence of a temporary suspension of vitality.

NOTES ON BRITISH SPECIES OF CORTICIUM.

By E. M. Wakefield, F.L.S.

WITH PLATE 3.

Of Basidiomycetes, the *Thelephoreae* have perhaps received least attention among mycologists generally, the reason being probably the difficulty of finding satisfactory names for species. The old descriptions are usually quite inadequate, and little can be added to them from the examination of dried material preserved in herbaria. The examination of several species of *Corticium* and allied genera in the fresh state convinced the writer that in this condition many interesting microscopic characters may be observed, which are often entirely lost sight of in dried material.

In some of the more delicate hypochnoid species, such as *C. botryosum* Bres., the very thin-walled mature basidia collapse as soon as the spores are shed, or after being subjected to drought, and as a rule resist all efforts to revive them. This fact probably accounts for these species having been long overlooked, for they can only be recognised as basidiomycetes when fresh and vigorously growing. When dried they may easily be mistaken for the sterile mycelium of a "mould," especially those species, such as *C. botryosum*, in which clamp connections are not present.

Many species are well characterised by the structure of the basal tissue,—whether close or open, etc.—or by the presence of vesicles, or swollen hyphae having the appearance of laticiferous tissue. These structures collapse on drying, and in many cases the application of reagents to swell them out causes changes to take place in the contents, and sometimes even in the walls of the hyphae. Some of the more fleshy species may be revived simply by moisture, after being dried for some months, and can be examined as if fresh. (Buller* found that *C. laeve* recovered after being dried for twelve months.) In many of these, however, after desiccation for about eighteen months

* Researches on Fungi, p. 111.

or more, the application of swelling reagents will not at all or only slightly reproduce some of the finer structural details that characterise them when fresh,—though much depends on the condition of the specimen when gathered. Hence "type" specimens of these plants are often of little value except for spore comparisons—if it can be proved that the spores present belong to them,—which is by no means always the case.

Another difficulty lies in the variability of these Fungi. Details such as the nature of the margin, the thickness of the tissue, or the degree of compactness of the hymenium, appear to be merely a question of the age and vigour of the individual. In *C. laeve* the hymenium may sometimes become so irregular and warted as to resemble that of the genus *Radulum*. This species also, when growing on a vertical surface, often produces well-marked pilei like a *Stereum*.

The microscopic structure may also show variability. In some species the size of the spore is fairly uniform, but in others the spore measurements are very variable, and the shape of the spore appears to be a more constant and recognisable character. Many species of *Corticium* may produce sterile outgrowths of various kinds, and thus approach *Peniophora*. In fact the distinction between *Peniophora* and *Corticium* does not appear to be so sharp as was originally supposed, *C. sambuci*, for instance, often shows irregularly scattered trichome-like outgrowths of the hymenium, more or less encrusted with particles of calcium oxalate (" cystidioles "). *C. laeve* has occasionally smooth-walled, fusiform, projecting cells—approaching certain species of *Peniophora* Cke. with smooth-walled cystidia. *C. sanguineum* has sometimes scattered definite cystidia-like outgrowths, resembling in form those of typical species of *Peniophora*, though much more slender. This species has in fact been transferred to the genus *Peniophora* by Bresadola. Two other species which have recently been transferred to *Peniophora* are *C. lacunosum* B. & Br., which according to von Höhnel is identical with *P. byssoides* Karst., and *Hypochnus longisporus* Pat., a remarkable species which I have once found at Kew. These two species have abundant erect pointed outgrowths (septate in *C. lacunosum*), but these are more or less narrowly cylindrical and scarcely differentiated from the ordinary hyphae, while the general structure is that of a *Corticium*.

The definition of the genus *Peniophora* is at present somewhat vague. It is proposed to undertake a thorough revision of the British species of *Corticium* and *Peniophora*, from the examination of fresh material, and in the meantime it is thought that some notes on those species of *Corticium* which have been identified and studied up to the present may be of service. Advantage is taken of this opportunity to appeal for fresh

material of these two genera, and to those members of the British Mycological Society and of the Yorkshire Naturalists' Union who have already assisted me in this way, I wish to express my best thanks. My thanks are also due to the Abbé G. Bresadola, who has kindly confirmed my determinations of species described by him.

C. laeve Fr. Epicr. 560 (Pers. Disp. Meth. Fung. p. 31, 1797) = *C. evolvens* Fr. Epicr. p. 557. Pl. 3, figs. 23, 24.

A very variable species. Sometimes entirely adnate (= *C. laeve*), sometimes, when growing on a vertical surface, forming distinct reflexed, white, strigose pileoli (= *C. evolvens*). The hymenium when fresh is smooth and waxy, usually more or less undulate, but sometimes coarsely tuberculate, especially towards the centre, like a Radulum. Young specimens may be entirely cream-coloured, but in mature specimens the colour varies from pinkish-ochre or livid to brownish when old; when dry pale buff with a pinkish or lilac tinge (Klinks. and Val. Code de Coul. n. 103 C-D). The hymenium usually becomes much cracked in an areolate manner when dry. Young specimens are entirely adnate, with a white, silky, shortly radiating margin; in older specimens the white margin disappears, and the edge tends to become upturned, especially on drying. The best characteristic of the species is the shape of the spores, which are rather large, piriform or pip-shaped, usually slightly incurved at the base, $9\text{-}12 \times 6\text{-}7{\cdot}5\mu$, generally $11 \times 6\text{-}7\mu$.

The plant here described is that generally accepted as *C. laeve* by mycologists. An examination of a type specimen from Fries of *C. evolvens* in the Kew Herbarium proves that the two species are identical.

C. sambuci Fr. Epicr. 565 (Pers. Disp. Meth. Fung. p. 31, 1797) = *Thelephora sera* Pers. Syn. p. 580, 1801. Pl. 3, figs. 1, 2.

This species is not confined to elder, but may grow on bark and wood of various kinds, and I have once seen it running over grass and soil with the habit of *Sebacina incrustans* Tul., having started probably from a half-buried stick. When fresh it is entirely pure snow-white or chalk-white, and only becomes slightly tinged cream on drying. It is inseparable and the margin indeterminate.

The tissue consists of rather loosely-interwoven hyphae, $3\text{-}4\mu$ wide, sometimes with scattered minute crystals adhering to the outer walls; clamp connections present at the septa. Sterile outgrowths occur in the hymenium, which are narrowly fusoid, often expanded into a knob at the apex, and these too may be encrusted with tiny crystals. Spores broadly elliptical, appear-

ing almost subglobose under a low magnification, with a small lateral apiculus, $4\text{-}6 \times 3\text{-}4{\cdot}5\mu$, and usually containing a single oil-drop near the base.

The white species of *Corticium* present most difficulties in identification. *C. arachnoideum* forms a separable pellicle when well developed, and differs from *C. sambuci* in its more cylindrical spores, which however may vary considerably in size. The name "*C. calceum* Fr." should apparently be dropped, as it is not an entity. In the Kew Herbarium there are several specimens from Fries, some of which are *Peniophora*, and one an unrecognisable species of *Corticium*. According to Bresadola* the true *Thel. calcea* of Persoon is a *Sebacina* (= *S. calcea* (Pers.) Bres.). I have received this species once from Sussex. I have not yet seen anything I could refer to *C. lacteum*. There occur in Britain a number of other white or pale-coloured species which apparently have been hitherto overlooked: one or two of these are evidently quite common. Some of these have been identified with species recently described by Continental mycologists, and are here given as the first British records.

C. trigonospermum Bres. (in Ann. Myc. 1905, p. 163). Pl. 3, figs. 3, 4, 5.

Thin, irregularly effused, chalk-white or becoming slightly tinged with cream, margin quite indeterminate. Hymenium with a slightly granular or mealy appearance under the lens. The structure is loose and hypochnoid, the basal hyphae $2{\cdot}5\text{-}3\mu$ wide, with clamp connections at the septa, sometimes slightly encrusted with minute crystals. Basidia 5μ wide, $20\text{-}25\mu$ long, with 2-4 straight sterigmata, $2\text{-}3{\cdot}5\mu$ long. Spores in face view with 3 rounded arms, indented between them, 5μ diameter; in profile more or less elliptical, flattened on the inner side and swollen towards the base on the outer side.

On pine bark, Forres, foray, Sept., 1912.

Distinguished from all other species by the shape of the spores. Von Höhnel† and Brinkman‡ have stated that it is a young form, or a variety, of a species of *Tomentella* (with warted spores). In the specimen I received the spores were remarkably uniform in size, and to all appearances quite mature, and there was no trace of any other form of spore. Bresadola (in litt.) states that "*Tomentella trigonosperma*, von Höhnel" is a distinct species.

* Fung. Trid., p. 64.

† Sitz-ber. d. k. Akad. d. Wissenschaft, Wien., Math. nat. Kl. Bd. cxvii., 1908, p. 1090.

‡ Bot. Zeit, 1909, Abt. ii., p. 259.

C. confine Bourd. & Galz. (in Bull. Soc. Myc. Fr. 1911, p. 260-261). Pl. 3, figs. 12, 13, 14.

Effused, thin, at first snow-white and arachnoid, hymenium eventually becoming deep cream-coloured or ochraceous, but the margin always pure white and byssoid in good specimens. Hymenium not continuous, but consisting of minute irregular areas, to the naked eye somewhat resembling a *Grandinia;* the granules waxy when fresh and closely packed, but when dry shrinking away from one another and revealing the thin white fibrillose subiculum. Structure loose and hypochnoid. Basal hyphae 2-4μ, with clamp connections, and often inflated at the septa. Basidia 3-5μ wide, with 2-4 straight or slightly curved sterigmata, 2-4μ long. Spores subglobose, pointed at the base, usually containing one oil-drop, $3\text{-}4 \times 2\text{-}3\mu$.

On rotten wood, bark, etc., of various trees, mycelium often forming fine branching cord-like strands beneath the bark. It appears to be very common, but has probably been confused with young stages of *Hydnum farinaceum*, which it superficially resembles. It differs, however, in the persistently smooth spores.

Kew (abundant); Mulgrave Woods, near Whitby; Clyne Woods, near Swansea.

First recorded in the " Naturalist," Jan., 1913.

The above description applies to vigorous well-developed specimens. In poorly developed forms the tufts of basidia may be so minute as to resemble a mould; and in young stages the hymenium is sometimes developed on fine anastomosing threads, such as occur in *Phlebia vaga* Fr.

C. botryosum Bres. (in Ann. Myc. I., p. 99, 1903). Pl. 3, figs. 15, 16, 17.

Forming a delicate, pulverulent layer, resembling a mould in general appearance, whitish at first, then greyish or glaucous, with a tinge of yellow here and there when old, separable as a thin film. Margin quite indeterminate. Basal hyphae slightly yellowish, broad, 9-10μ wide, branched at right angles, frequently septate, and with no clamp connections. Basidia scarcely distinct from the hyphae, $20\text{-}25 \times 9\text{-}10\mu$, with 2-6 stout, slightly curved sterigmata, 3-4μ long. Spores of a peculiar shape, in face view elliptical or almond-shaped, in profile flattened on the inner side and swollen on the outer side (navicular), $8\text{-}10 \times 4\text{-}5\mu$ (most $9 \times 5\mu$).

On very soft rotten wood; apparently not uncommon. Epping Forest; Kew.

C. subcoronatum v. Höhn. and Litsch. (in Sitzber. d. k. Ak. d. Wissensch. Wien., Math-nat. Kl. CXVI., Abt. 1, 1907, p. 822).

Resembles *C. botryosum* in habit, and occurs much more commonly in similar situations. It differs in having well-developed clamp-connections at every septum, and in the usually narrower spores, but possibly is only a form of that species.

C. albo-stramineum comb. nov. *Hypochnus albo-stramineus* Bres. (in Ann. Myc. I., 1903, p. 110). Pl. 3, figs. 9, 10, 11.

Effused, rather thick, separable, at first whitish, then deep cream, or pale straw-colour. Hymenium rather loose and pulverulent under the lens, the margin thin and indeterminate, not cracking when dry.

The structure is rather loose. The basal tissue consists of interwoven hyphae, 5-6μ wide, branched and much septate, with clamp-connections at practically every septum. From the basal hyphae arise scattered erect, cylindrical, elongated, cystidia-like bodies (45-120 $\times$ 6-9μ), with thin walls and rather deeply staining contents, which traverse the hymenium and sometimes project slightly above it. Nothing is known as to the nature and functions of these bodies. They have been called "gloeocystidia" by Continental mycologists, and a new genus *Gloeocystidium* established to include those species of *Corticium* which show them. The author, however, prefers for the present to keep them in *Corticium.*

The basidia are 8-9μ wide above, tapering below, and rather variable in length, according to the thickness of the tissue. Spores broadly elliptical, or subglobose, rather thick-walled, with granular contents, 7-9 $\times$ 6-8μ. The spore-walls have been described as finely warted, and usually appear so in fresh specimens; but on the application of swelling reagents, or in dried spores which have lost their contents, the uneven outline disappears, so that it is probably due only to the granular nature of the cell-contents.

On bark, fallen twigs, etc. Not uncommon.

Corticium lactescens Berk. (Outl. p. 274). Pl. 3, figs. 6, 7, 8.

When fresh and in good condition this is a beautiful plant, with a pure white narrowly radiating margin, and a thick, soft, waxy hymenium, whitish to clear flesh colour, or pale brown-pink. I have not gathered it myself, and in the specimens which have reached me I have not been able to detect any flow of milk when broken,—possibly this character is evanescent. The smell resembling that of *Lactarius quietus* mentioned by Berkeley is quite distinct in good specimens. In section the tissue

contains numerous closely-crowded, laticiferous hyphae, with highly refractive contents. These arise from the base and run parallel right to the surface, sometimes projecting slightly above the hymenium and giving it a pruinose appearance under a lens. When broken under a cover-glass the contents of these hyphae come out as a cloudy fluid.

The spores are broadly elliptical with rather blunt ends, with a lateral apiculus, $6\text{-}9 \times 4\text{-}6\mu$ (most $7{\cdot}5 \times 5\mu$), and have dense granular contents.

On drying, the colour becomes dull pale brownish, and the hymenium shrinks and becomes cracked with short cracks in all directions, showing the thick white fibrillose tissue in the interstices.

C. polygonium Fr. Epicr. 564 (Pers. Disp. Meth. Fung., p. 30, 1797.) Pl. 3, figs. 21, 22.

Begins as small erumpent cushions, from which the hymenium spreads centrifugally over the bark. In section this species also shows a system of laticiferous or storage (?) hyphae, consisting of rather coarse hyphae with densely-staining contents, which run up from the base and end beneath the hymenium in large pear-shaped or subglobose vesicular swellings, and are especially abundant in the central tubercle. The spores are cylindrical, slightly curved, with a lateral apiculus, $10\text{-}13 \times 3\text{-}4\mu$.

C. sanguineum Fr. (Epicr. p. 561). Pl. 3, figs. 18, 19, 20.

The hymenium when in good condition is creamy-white, or with a faint tinge of pink. Hyphae $3\text{-}4\mu$; spores elliptical, with a slightly curved apiculus, $5\text{-}6 \times 2\text{-}3\mu$. Cystidia pointed, slender, thin-walled, slightly encrusted, easily broken off and overlooked, $40\text{-}60 \times 5\text{-}6\mu$ (at the widest part).

C. caeruleum (Schrad.) Fr. (Epicr. p. 562). Pl. 3, fig. 26.

Spores hyaline, ovate-elliptical, $7\text{-}9 \times 4\text{-}6\mu$, rather variable in size. I have once found a second blue species, to which however I have as yet been unable to give a name. It is paler than *C. caeruleum*, and has the structure of a *Hypochnus*, and differs especially in having irregularly shaped bluish spores.

C. comedens Fr. (Epicr. p. 565). Pl. 3, fig. 25.

Is sometimes confused in the field with *Radulum laetum* Fr., which is frequent on hornbeam, and develops beneath the bark exactly like *C. comedens*. The latter is however known by its large sausage-shaped spores, usually $20\text{-}22 \times 6\text{-}7\mu$. *R. laetum* is probably only a form of *Peniophora incarnata*.

EXPLANATION OF PLATE 3.

All figures are × 800.

Figs. 1 & 2. *C. sambuci;* 1, section of hymenium; 2, spores.

" 3-5. *C. trigonospermum;* 3, basidia; 4, spores; 5, basal hyphae.

" 6-8. *C. lactescens;* 6, basidium; 7, "gloeocystidium"; 8, spores.

" 9-11. *C. albo-stramineum;* 9, "gloeocystidium"; 10, basidia, young and mature; 11, spores.

" 12-14. *C. confine;* 12, basidia; 13, spores; 14, basal hyphae with characteristic swellings.

" 15-17. *C. botryosum;* 15, basidia, young and mature; 16, spores; 17, basal hyphae, showing branching at right angles.

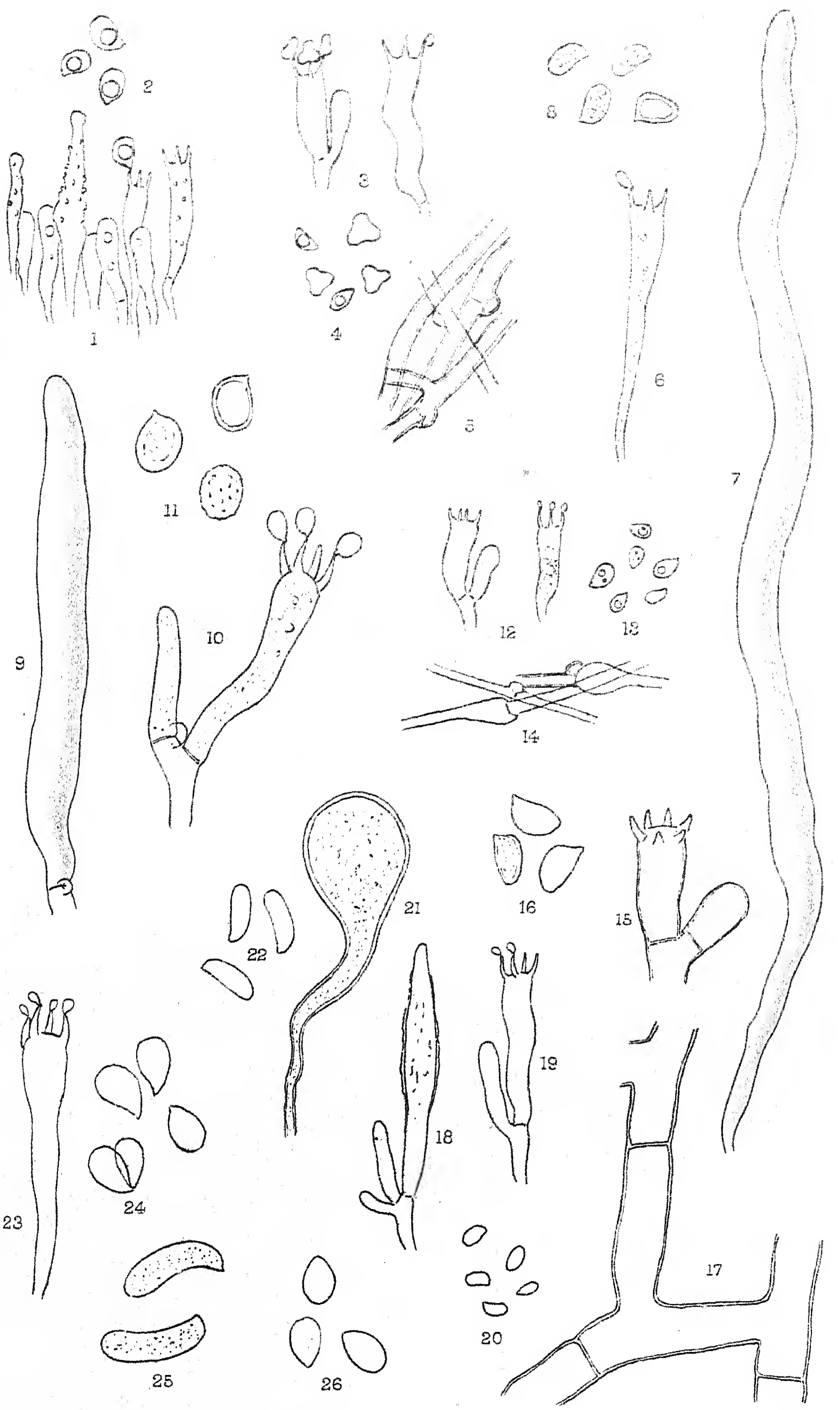
" 18-20. *C. sanguineum;* 18, cystidium; 19, basidium; 20, spores.

" 21-22. *C. polygonium;* 21, "gloeocystidium" with characteristic swollen head; 22, spores.

" 23-24. *C. laeve;* 23, basidium; 24, spores.

" 25. *C. comedens;* spores.

" 26. *C. caeruleum;* spores.



E.M.W. del.

West, Newman lith.

SIGMOIDEOMYCES CLATHROIDES.

A NEW SPECIES OF FUNGUS.

By Jessie S. Bayliss Elliott, D.Sc. Birm., B.Sc. Lond., Lecturer and Demonstrator in the Botanical Department, University of Birmingham.

WITH PLATE 4.

Amended generic diagnosis. *Sigmoideomyces* Thaxter. Fertile hyphae septate, bent into many S-shaped curves, branched or almost dichotomous, the outermost branches sterile. Conidiophores vesicular, borne laterally on the hyphae by a stalk, sterigmata short, spine-like and scattered. Conidia, one-celled, spherical, almost hyaline.

Description of species. *S. clathroides.* Fructification, a minute globose cancellate perithecium-like structure, diameter 200 to 230μ, hyphae very much branched, intricate, branches sigmoid, some tapering, ending freely and projecting radially, others anastomosing; conidia round, 11 to 13μ diameter, colourless, smooth, borne on short sterigmata which arise from large spherical conidiophores mounted on short paired lateral stalks; walls of hyphae thin at first, later thick, septa numerous when young.

This fungus appeared in the Zoological Laboratory, Birmingham University, April, 1910, on three or four cultures of damp soil containing dead earthworms, belonging to Mr. G. Johnson, who was investigating earthworms.

Each culture was enclosed either in a glass or a tin box. The soil had been in the boxes about six months when it was seen to be studded with hundreds of minute fawn coloured spots, which on being examined microscopically proved to be ball-like masses of hyphae, and were thought to be perithecia belonging to some species of *Gymnoascus*, for, in the first specimens examined no conidiophores could be seen and the conidia themselves suggested immature asci containing numerous ascospores.

The mature fructification is a minute spherical mass of interlacing hyphae, forming a kind of loose perithecium-like structure, such as is seen in *Gymnoascus*, and encloses a dense mass of conidia, and radiating out from the periphery are many curved hyphae. (Fig. 7.)

When the fructification is examined closely under high magnification, the hyphae will be seen to be arranged on a definite plan and the conidia to be grouped together into rather indefinite masses. On teasing out a fructification, among the conidia will be distinguished large vesicular conidiophores studded over with minute projections, evidently the remains of short sterigmata to which the conidia were attached (Fig. 5, b); sometimes, though rarely a few conidia are seen still attached to the conidiophores (Fig. 4). Although the hyphae evidently radiate out from a centre on a definite plan, it is impossible to make out what this is near the centre, but towards the periphery radiating out from wide S-curved central hyphae are sickle-shaped hyphae (Fig. 1, a); from these other curved hyphae branch off, some with tapering ends remaining free and projecting out (Fig. 1, b), others becoming attached to similar hyphal branches (Fig. 1, c), and so the whole structure has a cancellate appearance.

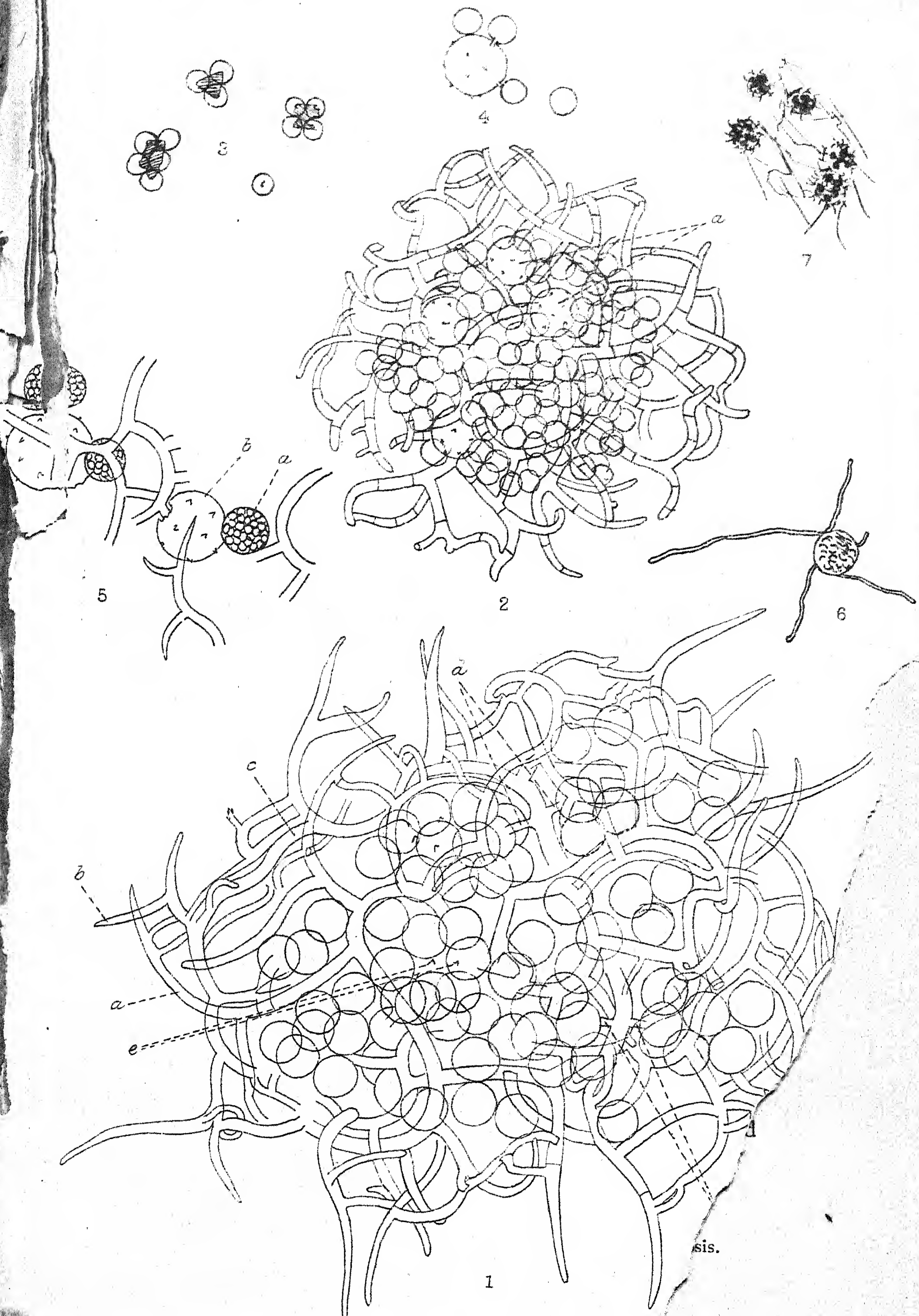
It is difficult to make out the attachment of the conidiophores, but pairs of branches from the large central hyphae lose themselves in the conidia masses, hence it is inferred that the vesicular conidiophores are attached to these (Fig. 1, d).

In a younger stage (Fig. 2) the perithecial hyphae are very septate and thin walled, and the hyphal branches radiating peripherally are somewhat blunt and short. At this stage great care is needed when putting a cover glass over the fructifications, since they are rather brittle and easily crushed, breaking up into fragments. With careful focusing the vesicular conidiophores are easily seen (Fig. 2, a).

The conidia are quite colourless, round and smooth, 11 to 13μ in diameter, and in young stages contain one large oil drop which later breaks up into very many small ones (Fig. 5, a). They are difficult to germinate, only three or four have been seen to send out germ tubes, which however soon ceased to grow (Fig. 6). It is not easy to disentangle the conidia from the perithecium-like structure, and yet in very old cultures the conidia evidently become detached and disappear, for many unbroken perithecium-like envelopes are found which are quite void of conidia and conidiophores.

In many instances very fine hyphae are found attached to the fructifications connecting groups of them together, these are doubtless the vegetative hyphae (Fig. 7).

Many attempts were made to get cultures of the fungus on various media and on soil, but without result, yet when certain black-looking soil such as that obtained from the University grounds, was moistened and shut up for six weeks or more in small tin boxes and a dead worm (*Lumbricus terrestris*) was buried in it, in 50 per cent or more of the cultures the fungus appeared. There thus seems to be some association between



J.S.B.E. del.

Sigmoideomyces clathroides *Baylis.*

the worm and the fungus, for the fungus never appeared in the control boxes of soil which did not contain worms.

The fungus never appeared in cultures made from worm casts, nor on cultures in which sandy soil was used instead of black soil.

This fungus evidently belongs to the genus *Sigmoideomyces* originally described by Thaxter, of which only one species *S. dispiroides* Thaxt. has been recorded, and that was found in North America.

This species presents several features which distinguish it from *S. dispiroides;* its conidiophores are attached to main hyphae by short hyphae instead of by long and thin ones, the conidia are smooth and not rough, while the hyphae forming the fructification anastomose so as to form a very characteristic cancellate perithecium-like structure.

It also seems closely related to another North American genus *Thamnocephalis (quadrapedata* Blakeslee), but in this the globose fructification is not cancellate, and it is mounted on a long stalk which is connected with very prominent rhizoid structures.

The great resemblance of this fungus to the perithecial stage of a *Gymnoascus* seems to suggest that it may perhaps be a conidial form of some species of that genus.

Sigmoideomyces clathroides is a fungus which has not hitherto been recorded, and this is apparently the first record of the genus *Sigmoideomyces* being found elsewhere than in North America.

* Latin diagnosis of *Sigmoideomyces clathroides.*

Hyphis sterilibus paucis repentibus tenuissimis, fertilibus in massam globosam 200-230μ diam. perithecioideam compactis, ramosissimis, intricatis, ramulis sigmoideis, aliis liberis falcatis radiatim protrusis, aliis interioribus crebre anastomosantibus; conidiophoris magnis sphaericis geminatis ramulis brevibus suffultis; conidiis globosis levibus hyalinis 11-13μ diam. e sterigmatibus curtis spinosis oriundis; hypharum septis juniorum numerosis, lateribus primo tenuibus senio incrassatis.

EXPLANATION OF PLATE 4.

Fig. 1. Mature fructification × 504.

a, sickle-shaped hypha branching off from large S-curved central hypha.

b, tapering branch, projecting from fructification.

c, branch connecting two sickle-shaped hyphae.

* I have to thank Mr. W. B. Grove, M.A., for this Latin diagnosis.

d, paired branches, each disappears into a mass of conidia and is presumably connected with the spherical conidiophore bearing them.

e, sterigmata arising from a conidiophore.

Fig. 2. A young fructification showing numerous septa × 300.
a, spherical conidiophores with minute sterigmata.

Fig. 3. Groups of young conidia attached to fragments of the conidiophore × 504.

Fig. 4. Conidiophore with two conidia attached by short sterigmata × 504.

Fig. 5. A piece of the mature fructification teased out × 800.
a, mature conidium filled with oil drops.
b, conidiophore.

Fig. 6. Germinating conidium after 24 hours.

Fig. 7. Groups of fructifications connected together by vegetative hyphae as they appear growing on soil × 93.

NEW BRITISH FUNGI.

By John W. Ellis, M.B., F.E.S.

Phoma strobiligena Desm. var. *microspora* Sacc. Syll. III., 150

Perithecia almost superficial, gregarious, black, rugulose, opening by a minute pore at the apex of a slightly conical ostiole, then becoming collapsed. Spores oblong-oval, rounded at both ends, continuous, occasionally biguttulate, 4-6μ × 2-2·5μ, hyaline.

On the scales of the cones of *Pinus sylvestris*, Storeton (Cheshire), April, 1912. Confined to the exposed (rhomboidal) area of the scale.

Macrophoma fraxini Delacr. Bull. Soc. Myc. Fr. (1890) 140. Sacc. Syll. X, 191.

Perithecia gregarious, subepidermal, slightly convex, causing the surface of the bark to appear like a rasp, opening through the epidermis with a round or stellate pore. Spores cylindraceo-elliptical with rounded ends, thick walled, with granular contents, continuous, 20-25μ × 7-8μ, hyaline.

On a fallen twig of *Fraxinus excelsior*, Bebington (Cheshire), Feb. 10, 1912.

Coniothyrium olivaceum Bon. var. *Sarothamni* Sacc. Syll. III., 306.

Perithecia gregarious, sub-epidermal, more or less globular, slightly elevating the cuticle so that the surface appears roughened, discharging the spores through a small circular pore. Spores elliptical, rounded at both ends, continuous, 5-6μ × 3μ, pale olive-brown.

On dead twigs of broom, Bidston Hill (Cheshire), May 19, 1911.

I am unable to find any record of the occurrence in Britain either of the type form of this species, which appears to be generally distributed throughout Europe, or of any of its numerous named varieties.

Ascochyta acori Oudem. Contr. Flor. Myc. du Pays-Bas. XVI. 68. [Rab. 1793].

Perithecia minute, convex, black, scattered sparingly over red-brown blotches on the leaves. Spores more or less cylindrical, rounded at each end, 2-celled, with the septum often irregularly placed so as to make the cells unequal in size, hyaline, slightly granular, 25-28μ × 7-10μ.

On living leaves of *Acorus calamus* in the Mollington Canal, Wirral, Cheshire, May 18, 1912.

Hitherto only recorded from Voorberg, Holland. The perithecia are so small as to be scarcely recognisable except with a lens.

Hendersonia vulgaris (Desm.) Sacc. Syll. III., 427.

Perithecia epiphyllous, minute, globose, black, shining, sparingly scattered over irregularly shaped rusty or grey spots which have purplish-brown margins. Spores ellipsoid, rounded at the ends, 3-septate, 15μ × 6·5μ, yellow-brown.

On dying leaves of *Rubus fruticosus*, Bidston Hill (Cheshire), August 22, 1911.

Septoria digitalis (Passer.) Sacc. Syll. III., 534.

Perithecia minute, scattered over irregular fuscous spots which at length become withered. Spores filiform, continuous, multinucleate, 25-30μ × 1·5μ.

On leaves of *Digitalis purpurea*, Hadlow Road, Cheshire, July 29, 1911.

In my specimens the perithecia are convex, black, shining, and perforated by a minute pore, and each stands within a darker, circular, slightly elevated area of the general macula which occupies one-third of the leaf. The spores vary from elongate-cylindrical with rounded ends, straight or slightly curved, 15μ × 4·5μ to filiform and flexuous, 28μ × 1·5μ

Septoria lunariæ, nov. spec.

Peritheciis minutis (100-150μ diam.), subglobosis, atris, nitidis, poro minuto apertis, in maculis nebulosis nigris sub-opacis sparse disseminatis. Sporulis cylindraceis, leviter curvulis, utrinque subacutis, primo pluriguttulatis vel 1-2 septatis dein 4-5 septatis, 25-30$\mu \times 3\mu$, hyalinis.

Ad paginem exteriorem siliculorum *Lunariæ biennis*, Wallasey (Cheshire), July, 1911.

The perithecia were not fully developed on the discoloured pods until after they had been kept for some weeks in a moist condition. The earlier sporules were ovate-elliptical and uniseptate or with a few (1-4) guttulæ; finally the complete stage of development appeared to be the cylindrical cell with 4-5 septa.

Septoria plantaginis (Ces.) Sacc. Syll. III., p. 554.

Spots grey, roundish, at first with a distinct margin. Perithecia minute, covered by the epidermis which is slightly raised above them and finally pierced by a small pore from which the spores protrude as a greyish tuft. Spores filiform, slightly curved, continuous or faintly and distantly septate, 40-60$\mu \times 2{\cdot}5$-3μ, hyaline.

On the dried specimens the centre of the spot forms a roughened greyish crust, which appears to distinguish this species from the *S. plantaginea* Passer. Recorded hitherto (teste Sacc.) from Northern Italy and Germany.

On leaves of *Plantago lanceolata*. Not uncommon in the Wirral district of Cheshire during the summer of 1911.

Septoria stemmatea (Fr.) Sacc. Syll. III., 493.

The character of the spores of this species appears to be unknown to Saccardo. On specimens collected on *Vaccinium Myrtillus* on Helvellyn in September, 1911, I find that the spores are elongate cylindrical or filiform, indistinctly septate or multiguttulate, 18-22$\mu \times 2\mu$, hyaline.

Phlyctaena fraxini, nov. spec.

Pustulis gregariis, subconvexis, primum epidermide velatis demum vix erumpentibus sed poris irregulariter rotundatis corticis expositis, nigris, opacis. Sporulis filiformibus, forte uncinatis, 20-22$\mu \times 1\mu$, hyalinis.

In cortice ramulorum *Fraxini excelsioris* socia *Phoma scobina* Cke., Brace's Leigh Wood, prope Malvern, May, 1912.

Probably closely related to *P. phomatella* Sacc. (Syll. III., 594) but differing in the very distinct host plant.

RECENT PUBLISHED RESULTS ON THE CYTOLOGY OF FUNGUS REPRODUCTION.

By J. Ramsbottom, B.A., Assistant, Department of Botany, British Museum.

In a paper under the title "Work published during 1911 on the cytology of fungus reproduction," in the last number of the Transactions of this Society, the present writer gave a résumé of the papers published during that year, which had come to his notice by the end of January 1912. It was fully realised that some important papers would be missed. As it seems desirable to give an annual account of the advances in the subject, the title has been changed and work which has not been noticed in the one year will be incorporated in the following year's account.

The results which have been published during the year are of absorbing interest. With the vast amount of research at present being undertaken, it would seem that in a comparatively short time, we should have more definite agreement with regard to many of the phenomena.

A section of the Phycomycetes which are extremely interesting in many ways and particularly from a phylogenetic point of view are the Archimycetes, a group of microscopic fungi usually infecting water plants and remarkable for the little vegetative structure they possess. As in the case of many apparently simple organisms, opinions differ as to whether they are primitive or reduced forms. The group is known chiefly from a morphological standpoint; what little cytological results we possess often deal with such detailed and highly complicated nuclear phenomena that an account of them would seem rather out of place here.

Barrett (1912) has worked at three species of *Olpidiopsis*, *O. vexans* (= *O. Saprolegniae* A. Fisch.), *O. luxurians* and *O. Saprolegniae* Cornu. The species form two types of sporangia within the filaments of members of the Saprolegniaceae —the one a resting sporangium, the other a zoosporangium. The zoospores are biciliate having two equal cilia arising from the same point. One cilium, in motion, trails behind, and, crossing the upper end of the zoospore at an angle, and leaving it usually at the side, gives it the appearance of the short lateral cilium that has been described in this and in some

other closely related genera. There is in the genus a type of diplanetism, a phenomenon common in the zoospores of the Saprolegniaceae, i.e., the zoospores on liberation swim about actively, then come to rest for a time, then again become motile. The zoospore penetrates into the host and is after a brief time lost to view. Its individuality is maintained, however, and it gives rise to a single sporangium, there being no plasmodium formed. The young parasite is uninucleate, but soon the nucleus divides rapidly and the organism becomes multinucleate. The protoplasm is at first peripheral. Spore centres are formed before the resting period of the sporangium ensues. Fragmentation of the protoplasm is believed to be simultaneous throughout the sporangium much as described by Dangeard for *Synchytrium Taraxaci.* The so-called "resting spores" were found to be formed definitely by sexual processes in the three species, the manner of development being in general the same. The larger oogonium and the smaller adjacent antheridium are at first naked, but as growth proceeds they become more and more distinct and soon surround themselves with cell walls which become fused at the point of contact. Both cells contain a number of nuclei, twenty-five to thirty in the youngest oogonia seen, though the number in the later stages is not stated. The wall of the antheridium remains smooth while the oogonium early shows the formation of roughenings on the outer surface, which eventually takes on a warty appearance. The contents of the antheridium pass through a small fusion pore into the oogonium, which soon closes up by the growth of the surrounding wall. "There is no contraction of the oogonial protoplasm to form an oogonium and no apparent changes comparable to those taking place in oogenesis in the higher Oomycetes." After the completion of the act of fertilisation, some change takes place in the fused protoplasmic mass which alters its susceptibility to stains. "There is no apparent difference in the male and female nuclei, and this fact, coupled with their extremely small size, makes it impossible to definitely follow their subsequent relation to each other. However, there are indications which strongly suggest a fusion of nuclei." After fertilisation the oogonium becomes the oospore directly. The nuclei of both sporangia and gametangia are small. The resting nucleus possesses a deeply-staining, rather prominent nucleolus and a slightly granular nuclear plasm. A rather indistinct network with frequent deeply stained thickenings is present. The first stages of division resemble somewhat the synaptic knot of higher plants but, Barrett writes, "I do not believe that to be their nature." The chromosomes become massed together into a large, deeply staining body from

which the tips of the spindle appear to emerge. There is no indication of centrosomes or of any structure which would suggest nuclear polarity.

Undoubted sexuality is apparently rare in the group. In *Monochytrium*, Griggs (1910) found that the youngest stages observed in the cytoplasm of the host were small amoeboid uninucleate cells which usually fused in pairs. The nuclei do not fuse, but immediately after conjugation, growth begins and seems to proceed rather rapidly. Similarly in *Polyphagus Euglenae* according to Wager (1899) the two unicellular elements which fuse are uninucleated. After the fusion of the two protoplasms, there is a period of rest and the nuclei do not fuse until the time of germination of the zygote. According to Dangeard (1900), however, the nuclei fuse immediately. In *Myzocytium vermicolum* Dangeard (1906) found that there was fusion between an antheridium which usually possessed two nuclei and an oogonium with eight. One male and one female nucleus fused, the rest disorganised.

Griggs (1912) has worked at *Rhodochytrium spilanthidis.* Although this organism must be considered a fungus if we go by definition, it "seems to occupy a transitional position between the protococcoid algae [such as *Phyllobium*] and some of the chytridiaceous fungi. . . . It has no chlorophyll and is strictly parasitic in its mode of life. . . . Although entirely incapable of photosynthesis, it develops abundant starch. But the starch grains are apparently built up directly in the cytoplasm, for neither plastids nor pyrenoids have been found"—a "paradoxical combination of characters." The plant has more or less of red pigment in all its stages. There are two kinds of cysts—resting spores and zoosporangia. The youngest resting spores observed consisted of an elongated germ tube with an external button marking the size and position of the zoospore from which they originated. At the beginning of the enlargement of the basal portion the protoplast withdraws from the narrow neck of the germ tube, which is later cut off by a wall. The parasite has an extensive system of haustorial rhizoids proceeding from its basal portion. The protoplasmic contents become more abundant and denser. The nucleus increases in size but remains undivided and undergoes a metamorphosis, ultimately collapsing. "In this condition the nucleus differs so far from ordinary healthy nuclei that it is difficult to believe that this change is not pathological. But it seems to be a universal and perfectly normal phenomenon. On the beginning of germination in the spring, the nuclei again become turgid, though they are apparently smaller than before shriveling up." At the end of vegetative activity the rhizoids are ultimately cut off by cell walls and the mature

spore has a two layered cellulose exospore and a thick non-cellulose endospore. The zoosporangia are distinct from the resting spores from the very beginning. They do not form external buttons, and the neck, even at the very first, is of comparatively large diameter. Numerous rhizoids are put out from the base as in the case of the resting cyst. In the later stages of development there is always one large vacuole which occupies the upper half of the cyst, the protoplasmic contents except for a thin peripheral layer being confined to the basal portion. The cysts reach full size before there is any indication of nuclear division, but when division commences the stages follow each other in rapid succession until a large but variable number of nuclei have been formed. Upon the completion of the period of nuclear division segmentation appears to be brought about by the precipitation of membranes around the protospores. The protospores quickly round off and ultimately give rise to zoospores. These frequently contain starch grains, but are colourless except for the red anterior end. They are biciliate. "The cilia, which are anterior, are more highly specialized structures [than the cilia of the Chytridiales] and maintain a rapid vibration which propels the spore with the steady motion characteristic of algal zoospores in general, to which those of *Rhodochytrium* correspond in every important particular save in the absence of chlorophyll." The zoospores fuse in pairs when there is an insufficiency of fluid present. "The process of conjugation is not different from that common in various algae." The zoospores are uninucleate and there is a deeply staining body at the base of the cilia which is connected with the nucleus. From the youngest stages the nucleus of the resting spore and that of the zoosporangium undergo the same development which, in one case, leads to shriveling preparatory to the long dormant period, and in the other to mitosis. The most conspicuous of the changes in the nucleus is its increase in size. From 4 or 5μ it grows until it may reach the enormous size of 50 to 60μ in the largest zoosporangia. This amazing increase in volume recalls the proportionately much greater increase in the size of the nuclei in *Synchytrium.* The primary nuclei have enormous nucleoli and peculiar masses of chromatin, as in the case of *Synchytrium decipiens.* "In the first type of mitosis, the spindle, which is usually unipolar at first, is formed from coarse acicular fibers that appear within the nuclear cavity; it has no connection with the nuclear membrane. The spirem is formed from that part of the chromatin which lies in the equatorial region, the rest being cast out; it is frequently entirely within the spindle. The second type of mitosis presents no unusual features. No centrosomes or true asters were seen.

. . . . The cytology of *Rhodochytrium* bears a strong resemblance to that of *Synchytrium.* These resemblances suggest that *Synchytrium* was derived from protococcoid ancestors."

Much attention is at present being devoted to the cytology of the Mucorineae. These fungi had been previously rather neglected from a cytological standpoint, though both from a morphological and a physiological point of view they are better known than almost any other group. The cytological results are, however, all at variance. The problem of sex is here complicated by the fact that a physiological differentiation exists as well as a morphological one. In the sexual process two small branches, progametes, meet and become flattened at the point of contact. Each cuts off a terminal portion, the gametangium; the remaining portions are the suspensors. The wall between the gametangia is very quickly absorbed and a thick wall is developed on the outside of the chamber thus formed and the zygote or zygospore results. In the usual case, e.g., all species of *Sporodinia,* the gametangia are similar in every way, there is no morphological differentiation; the species are isogamous. In *Spinellus* some species are isogamous, but others are heterogamous, i.e., the gametangia are unequal in size. All stages from cases where the difference in size between the two gametangia is very slight to such genera as *Dicranophora* and *Zygorhynchus,* which are markedly heterogamous, occur.

It has long been known that whereas in some species such as *Sporodinia grandis,* zygospores often occur, in others, such as *Phycomyces nitens,* they are rarely met with. This, at first, was thought to be due to the influence of external conditions. Much work was done on the subject but little resulted except in the case of *Sporodinia,* where eventually it was shown by Klebs that the determining factor in the formation of zygospores in that genus was transpiration: a saturated atmosphere produced zygospores.

The matter was cleared up by Blakeslee (1904). Working first with cultures of *Mucor Mucedo* he found that the mycelium arising from the spores of a single sporangium never produced zygosores. In the case of mixed dilution cultures he found that an abundant growth of zygospores occurred at the line of apposition of certain of the mycelia, while between others this did not occur. A certain mycelium might produce zygospores when meeting with a second mycelium which itself would be sterile to a third mycelium also fertile to the first. This indicated that there were two different types of mycelia arising from different spores and that zygospores were produced only when different kinds of mycelia met. This was

found to be the case generally in those species where so few zygospores nad been seen previously. To this type of fungus Blakeslee gave the name 'heterothallic': the second type, where the mycelium produced from the spores of a single sporangium gives rise to zygospores, was described as 'homothallic.' In the case of *Mucor Mucedo* one mycelium is a little more robust than the other and to this Blakeslee provisionally gave the sign (+), the sign (—) denoting the second. In other species this slight difference is not seen, but owing to the fact that imperfect hybridisation takes place between different strains of different species, Blakeslee was able to arrange the strains of the whole of the species he studied under these two signs. An interesting point brought out by the investigation is that a species like *Zygorhynchus Moelleri*, which is very markedly heterogamous, may be homothallic. This has given rise to the view that such highly developed heterogamy far from indicating sexual differentiation indicates a tendency to azygospore formation—a loss of sexuality.

Sporodinia grandis (homothallic, isogamous) because of the frequency of zygospore formation, is the species which has been most studied. It seems to be, however, hardly a suitable species for the study of nuclear phenomena because of the large number of small nuclei in the gametangia, and the presence of oil globules and mucorine crystals.

Dangeard and Léger (1894) first showed that the zygospore was formed by the fusion of multinucleated gametangia. In the young zygospore there were two different sizes of nuclei, but later this differentiation could not be seen. They also recorded the disappearance of some of the nuclei. Léger (1894-5) continued the research and extended his observations to many other genera. The zygospores of *Sporodinia grandis* and *Mucor Mucedo* were particularly studied. Léger stated that in the zygospores the nuclei gradually disappear. At the precise moment of the completion of this disappearance, two groups of small spheres ("sphères embryogènes"), probably arising from the fusion of a certain number of nuclei, appear. At a later stage all the spheres of each group fuse forming the notorious "sphères embryonnaires," which themselves fuse at germination. Dangeard immediately dissociated himself from Léger's work. Gruber (1901) examined the zygospores of *Sporodinia grandis*. He found that there were numerous nuclei present. There was at first a short period of zonation (such as is common in many of the Peronosporineae) during which the nuclei were more numerous in the parietal layer. Afterwards they became evenly dispersed. He found neither disorganisation of nuclei nor nuclear fusion, though he assumed that the latter took place.

Dangeard (1906) worked at *Mucor fragilis* (chosen because its nuclei were few in number) and interpreted the phenomena seen in *Sporodinia* in light of the obtained results. In the former species a nuclear division takes place in the young zygospores. At a later stage the nuclei fuse in pairs. Afterwards nuclei of three sizes are seen which Dangeard interprets as being nuclei before, immediately after, and some time after fusion. The nuclei which fail to copulate disappear. Very similar results were obtained in *Sporodinia* but the phenomena were more difficult to observe, the number of nuclei in each gametangium being more than one thousand. In the old zygospores from ten to twenty rather large, deeply staining bodies were seen. They resemble coenocentra (such as are met with in the Phycomycetes) but are masses of mucorine crystals.

Lendner (1908) in his work "Les Mucorinées de la Suisse" recorded the results of his study of *Sporodinia*. His account of the early stages agrees with those of the other observers, but, he states, one of the progametes penetrates more or less into the other, the amount of penetration varying with the individual examined. There is thus a difference in form which Lendner thinks may be a sign of sexuality. Two large nuclei are present in the young zygospore, one from each gametangium, as well as numerous small nuclei. The latter which are disseminated everywhere but are more numerous near the walls, divide. Lendner thinks that Dangeard interpreted this division as a fusion. He holds that the same phenomenon occurs in the suspensors, where it can be more readily seen owing to the protoplasm being there less dense. The small nuclei, moreover, do not degenerate but seem to preside at the formation of the zygospore membrane. The two large nuclei later fuse and occupy the centre of the zygospore. He thinks that if Gruber and Dangeard missed these large nuclei it must be because their fixation was faulty. That Dangeard's results with *Mucor fragilis* may be correct he is quite prepared to admit, as he has never met with a single nucleus in sections of the zygospores of *Zygorhynchus Moelleri*, but on the contrary several nuclei dispersed regularly in the meshes of a uniform protoplasmic network.

Moreau (1911) published three notes on the Mucorineae. Concerning *Sporodinia* he says "La similitude des observations de Dangeard et des nôtres sur ce point nous dispensera, dans cette note preliminaire d'en donner le détail." In a species of *Mucor* favourable for study, each gametangium contained numerous nuclei in a vacuolated protoplasm. The number of nuclei is variable but much fewer than in *Sporodinia.* Shortly after fusion the nuclei show karyokinetic figures. This division (which Dangeard had assumed to take

place) shows the same characters as mitosis in the mycelium—two chromosomes, two centrosomes but no nuclear membrane, nor nucleolus. The spindles in the zygospore are shorter. As a general rule the nuclei of fungi preserve their nucleoli during division: " la disparation précoce du nucleole chez les Mucorinées donne à la division dans ce group une physiognomie toute spéciale." The absence of nuclear membrane is shared also with the Ancylistes and the Basidiomycetes but it is present in the Ascomycetes and most Siphomycetes. The protoplasm changes in character, becoming alveolar, then reticulate-alveolar, at the same time the membrane thickens and the zygospore surrounds itself with a spiny exospore. " A ce stade, la plupart des noyaux presentent des aspects qui ne laissent aucune doute sur l'existence des fusions multiples." All stages of fusion are met with in the same zygospore. Many of the nuclei disorganise without fusing. Fusion and disorganisation are however two concomitant phenomena: it is not a case of nuclei degenerating which have been unable to copulate.

Moreau extended his researches to both heterogamous and heterothallic species. He investigated four species of *Zygorhynchus* (markedly heterogamic but homothallic), *Z. Moelleri*, *Z. Vuillemini* and two unnamed species. The facts in the two first species are hard to establish, but they seem to agree with what takes place in one of the unnamed species. The first stages of development show nothing different from a nuclear point of view from what is met with in the isogamous Mucorineae. The young zygospore contains many nuclei of small size in a reticulate protoplasm. It is impossible to distinguish the nuclei coming from either gametangium after the fusion of the protoplasms. While the zygospore is young most of the nuclei fuse in pairs while the few remaining degenerate. In the last species of *Zygorhynchus* studied, the zygospore developed much further before the nuclear fusions: its spiny exospore is doubled with a thick endospore and its protoplasm is largely invaded by oil. All the nuclei except four by this time have begun to degenerate and have almost disappeared. The small number of the remaining nuclei is a guarantee of the disorganisation of the others. The four privileged nuclei have grown considerably but remain equally large. They fuse in pairs and finally the ripe zygospore contains two copulating nuclei, the last traces of the others having completely disappeared. *Absidia Orchidis* is a heterothallic species which is indifferently isogamous or heterogamous. The cytological phenomena, according to Moreau, appear to be the same in all cases. At the time when the zygospore commences to show the ornamentations on its membrane, numerous small nuclei are scattered through its protoplasm. A little later almost all of

them become arranged in pairs and fuse. The few which do not fuse degenerate. *Mucor hiemalis* (heterogamous, heterothallic) is apparently similar, but here the nuclei are large in size and few in number and the fungus is therefore particularly suitable for study.

The results obtained by Moreau seem quite consistent. A fusion of certain nuclei in pairs and a disorganisation of the rest occur in all the species examined. In the case where many nuclei fuse, the fusion takes place early; where the fusion takes place late, few nuclei fuse. The variation in the cases studied seems to arise according to whether fusion or disorganisation is dominant. We have not enough facts to know whether very marked dominance of disorganisation goes with marked heterogamy as in one of the species of *Zygorhynchus*. It is interesting to note that the phenomena seem to be identical no matter whether the species is isogamous, heterogamous, homothallic or heterothallic. There is greater variation in *Sporodinia grandis* according to the various published accounts than is recorded by Moreau for eight different species of four genera.

Gruber (1912) has taken up the study of *Zygorhynchus Moelleri*, but his results do not agree with those of Moreau. Zygospore formation usually begins, as Blakeslee and others have pointed out, by the union of the end portion of an upright aërial hypha with a side branch of the same hypha. The end portion, which becomes cut off by means of a transverse septum, has usually been interpreted as the male branch, but Gruber regards it as the female, and the larger side branch which curves and swells up into a club-shaped structure in applying itself to this as the male branch. At the place of contact arises a pear-shaped elevation (the progamete) perpendicular to the long axis of the female hypha, while the club-shaped end of the male branch builds the other progamete. Contrary to Blakeslee's statement, a septum was not formed in the male progamete but only in the female one. A cross septum is now partially laid down about the middle of the female gametangium; it arises from the periphery and is rarely completely formed, usually being soon dissolved. In the study of sections the male and female branches were seen to contain dense colourless protoplasm, that of the male branch being slightly less compact than that of the female branch. Numerous very small nuclei were distributed rather regularly in them. In the male progamete a portion of the protoplasmic contents containing from twenty to thirty nuclei separates off from the remainder. It differentiates clearly in staining, and is, according to Gruber, the male gamete. It applies itself to the membrane separating it from the female gametangium.

This it dissolves in one place and passes over, amoeba-like, through the small opening into the female gametangium, whereupon the opening in the membrane soon closes up again. The further behaviour of the nuclei could not be followed because of their small size, but the author holds it probable that the male nuclei fuse with a corresponding number of female nuclei. He also suggests that the nuclei in the female gametangium might undergo some differentiation into vegetative and generative nuclei when that structure becomes partially segmented. Since the zygospore (or oospore) contains a very large number of nuclei it appears that the fusion nuclei must divide repeatedly. Gruber holds that the processes recall what occurs in the Peronosporineae and the Saprolegniineae. They especially recall what occurs in *Achlya racemosa*, where Pringsheim saw amoeba-like bodies wander over to the oospheres from the antheridium and bring about fertilisation. He considers that *Zygorhynchus* can be regarded as occupying a position between the Zygomycetes and the Oomycetes, the transference of the male protoplasm of an antheridium to an oogonium being characteristics of the former, while the general habit and the method of sporangium formation show characters of the Mucorineae. The many small variations observed during the study, the vanishing cross wall in the female gametangium and the lack of a cross wall at the base of the male progamete leave the suspicion that the form dealt with is in a state of variation. Moreau (1912) immediately criticised Gruber's results. "Nous n' hésitons pas à dire que Gruber a été la victime d'une erreur." He considers that the large suspensor of *Z. Moelleri* has been mistaken for a reproductive structure: that the general method of zygospore formation by the fusion of two segments in all the Mucorineae has been disregarded; that it has been forgotten that the fusion in all the cases studied (and in particular in three species of *Zygorhynchus* near *Z. Moelleri*), presents all the characters of a gametangium, and that, lastly, all the homogeneity which the Mucorineae owe to the characters of their reproductive structure is taken away. Which of these totally divergent accounts is the correct one must be left to future research to decide. Moreau's work was known to Gruber when he published his results and must have been considered, as it is mentioned by him. It is certain that heterogamy cannot yet be considered as indicating a loss of sexuality.

McCormick (1912) has published a preliminary account of her work on *Rhizopus nigricans** (isogamous and heterothallic).

* Namyslowski (Bull. de l'Acad. des Sc. de Cracovie, p. 676, 1906) has worked at a form which he considers the true *Rhizopus nigricans*. In the filaments

Before the gametangia are cut off there appears a difference in the density and staining capacity of the protoplasms of the two suspensors and this difference persists until the zygospore is mature. The walls separating the gametangia from the suspensors may not be formed simultaneously. A central pore is left in each. Sometimes the wall separating the gametangia from each other thickens before disintegration. The many nuclei from each gametangium increase in size after the disintegration of the wall. All the nuclei except two disintegrate. These two nuclei are imbedded in a coenocentrum. " There are indications that the coenocentrum has its origin at the point of contact of the two suspensors before the gametangia are cut off. . . . Neither fusion nor division of the nuclei has yet been observed. It is believed, however, that the two nuclei left in the coenocentrum, fuse. . . . The coenocentrum persists until quite late, and in the mature zygospore there are many nuclei of the same size as those in the mycelium."

This seems to be the first case where a coenocentrum (so common in the Oomycetes) has been described as occurring in the Mucorineae. Every fresh contribution seems at present to add fresh perplexities. It would seem that Léger's work might be disregarded. His technique was primitive and consisted of direct sections and in dissections with the aid of needles. With such rough methods it would seem impossible for him to obtain reliable results, and certainly no reliance can be placed on such results as he did obtain. The modern work shows clearly that the gametangia are multinucleate. Division of nuclei is recorded in most cases, as also is a disintegration of certain nuclei. There are larger bodies present in some cases, but it hardly appears credible that what have been variously interpreted as mucorine crystals, large nuclei and coenocentra could be the same structures.

Bucholtz (1912) has published his work on the genus *Endogone.* This subterranean genus was previously little known and has been placed in various systematic positions by different mycologists. Brefeld placed it in his Hemiasci, a

there are enormous quantities of oval nuclei, elongated in the direction of growth. In the progametes the nuclei are uniformly distributed except at the apex where they assemble in enormous quantity. " On n'a observé ni la copulation ni la division des noyaux après la résorption de la paroi de séparation et après le fussionnement du protoplasme des gametes." The protoplasm in the zygospores is clearly reticulate and contains fat as reserve food material. The fungus can be apparently either isogamous or heterogamous as the suspensors as well as the gametes may be quite equal in size and shape or there may be great differences between them. Culture experiments showed the fungus to be homothallic, though the author does not appear to think that Blakeslee's observations have accounted for all the facts.

group established to include those genera which he considered transitional forms between Phycomycetes and Ascomycetes. Further work on the members of the group has shown that most of the genera first included are true Ascomycetes.

Bucholtz considers the morphology and systematics of the genus as well as its cytology. Seven of the seventeen known species were examined, *Endogone Ludwigii* being described as new.

In *E. lactiflua* the author discovered a sexual process resembling that of the Phycomycetes. The youngest stages of the fruit body found consisted of a tissue of branching hyphae surrounded by a sort of peridium formed by a layer of more firmly interwoven hyphae. The hyphae are multinucleate and have many irregular inflations but are non-septate. No nuclear divisions were observed in the hyphae. The male and female progametes arise as sac-like outgrowths of the hyphae. The species is heterogamous, the male progamete being usually smaller than the female. The nuclei in the progametes are arranged peripherally and undergo a simultaneous division such as has often been described in the Phycomycetes. There is no differention into periplasm and ooplasm in the female progamete as is recorded in many of the Peronosporaceae. At the end of the simultaneous division a nucleus appears in the centre of each progamete. It is not clear what the origin of these nuclei is but it is thought that one of the nuclei has wandered from the periphery. In each progamete the peripheral nuclei wander down into what is to become the suspensor. A cross wall is formed between these and the central nuclei. Thus two uninucleate gametangia or gametes (as the author prefers to call them) are formed. The process recalls what Oltmanns (1895) and Heidinger (1908) have described for the alga *Vaucheria*. If any nuclei remain over in the gametangia, they degenerate. (cf. Davis (1905) *Vaucheria*, and the many cases of such disorganisation in Phycomycetes). The septa are laid down in male and female outgrowths practically simultaneously. Almost at the same time copulation begins between the two gametangia. No receptive papilla or fertilising tube is formed. Meanwhile the two nuclei, which are respectively male and female, have grown considerably. There is an increase of chromatin, and an excentric nucleolus is visible in each nucleus. The male nucleus passes over into the female gametangium. The fusion pore is of various sizes: in some cases it was so small that the enlarged male nucleus was unable to pass through. The nuclei do not fuse. At the summit of the female gametangium a portion of the wall is gelatinised and a papillate outgrowth appears which gradually enlarges, and, as a rule, the whole of the contents of the gametangium passes over into

it. This outgrowth, which is the zygote or zygospore, enlarges further, rounds itself off and thickens its membrane. The nuclei were not observed to fuse, but it is thought that fusion occurs at germination. The zygote contains reserve food material, chiefly fat, and its membrane shows several layers. When mature, it is surrounded by a special envelope of hyphae, the walls of which fuse and thicken and in cross section give the so-called "Flammenkrone" appearance. (In an unnamed variety of *E. lactiflua* the nuclei appear to fuse during the ripening of the zygote.)

The only other species in which sexual reproduction was found was *E. Ludwigii.* This species was not worked out so thoroughly. In the youngest stages found, the zygote was already formed and the two empty gametes with their suspensors, had the appearance of appendages to it. In the zygote were seen either two nuclei, or one larger nucleus which presumably was formed by their fusion.

In *E. macrocarpa* and *E. microcarpa*, no zygotes were found in the fruit bodies but there were present asexually formed chlamydospores. These are pear-shaped or globose bodies formed at the ends of the hyphae and branches. The septa in the hyphae are few and oblique and there are frequent anastomoses. The protoplasm streams into the chlamydospore and a number of nuclei enter and arrange themselves peripherally. These divide and their number becomes very large. No fusion of nuclei was seen and there is no peridium formed The mature chlamydospore has fat bodies as reserve food material. The membrane is similar to that of the zygote of *E. lactiflua.* The author holds that because of its resemblance to a zygote, the chlamydospore might be considered as an azygote.

In *E. pisiformis* the young fruit body consists of a mass of pseudoparenchyma. From the base radiate non-septate hyphae forming a sheaf-shaped mass. The ends of the hyphae swell and become multinucleate sporangia, the protoplasm streaming into them just as in the chlamydospores. The nuclei undergo division as is shown by their form, arrangement, &c., but no division figures were seen. The sporangia are for a long time open to the stalk; eventually they are as a rule cut off by a transverse wall. The process of spore formation resembles that observed in many Mucorineae. It begins by the splitting up of the contents into irregular masses, the process commencing from the periphery. Finally the whole of the sporangial contents is divided into parts which through mutual pressure become polyhedral. Some parts remain undeveloped; the others divide so that at last the sporangium is full of equally large spores which are separated from one another

by a thin membrane. The sporangium wall remains thin and flexible. The further fate of the spores was not followed.

In *E. lignicola* and *E. fulva* the method of reproduction was not made out. Certain structures with many nuclei and a three-layered membrane which are present may be either sporangia or thin-walled chlamydospores.

The author proposes forming a sub-group (Endogoneae) in the Phycomycetes for the reception of this genus. He points out the close resemblance between the sexual process in the genus and that in the Mucorineae, and also the resemblances in the method of spore formation. He regards the swelling which afterwards becomes the zygote, into which the unfused male and female nuclei pass, as being possibly analogous to an ascogenous hypha. The development of vegetative hyphae round the zygote also recalls the Ascomycetes.

It is very interesting to find in this genus such differences from the ordinary Phycomycete type of sexual process. Whether they are to be regarded as being anything more than adaptations to a subterranean mode of existence seems doubtful. In any case it appears that the Phycomycetes have their hypogeal section as well as the Ascomycetes and Basidiomycetes.

In the Discomycetes we have to consider a remarkable contribution by Claussen (1912), who now publishes his full paper on *Pyronema confluens*. This species has long been a favourite for the study of the ascogonium and antheridium, which structures are very abundant and the largest and most conspicuous yet found among the Ascomycetes. The brothers Tulasne (1860 and 1866) were the first to notice these organs. De Bary (1863) and Kihlmann (1883) also worked at the species with the then-known methods.

Harper (1900) worked at the fungus with modern cytological methods. The cells of the mycelium are multinucleate. The sexual organs are early differentiated and there are several to each fruit. The ascogonium is a spherical or flask-shaped cell filled with dense protoplasm and many nuclei which are very much larger than those of the ordinary vegetative cells. The stalk consists of two or three disc-shaped cells. The antheridium is club-shaped, being wider near its upper end. It is also multinucleate and has a stalk of one or more cells. The upper end of the ascogonium projects as a trichogyne or connecting tube, whose contents are at first in direct communication with the ascogonium through its base. It is multinucleate at this stage and its nuclei are quite similar to those in the ascogonium. Soon a cross wall is formed at the base of the tube cutting it off from the ascogonium. During subsequent growth the nuclei of the trichogyne do not increase in size

as do those of the ascogonium and antheridium. The end of the trichogyne becomes firmly pressed against the antheridium and the conjugation pore is then formed, the walls around the pore thickening. The nuclei of the antheridium and of the ascogonium are of about the same size. The nuclei of the trichogyne swell up and finally disintegrate. When these are entirely disorganised a migration of the male nuclei into the trichogyne begins leaving behind the bulk of the antheridial protoplasm. At this time the nuclei of the ascogonium mass in the centre. The basal wall of the trichogyne breaks down and the male nuclei are admitted into the ascogonium and pass at once to the central mass of the egg nuclei and become mingled with them. There are upwards of two hundred nuclei from each cell. After the migration of the male nuclei is complete, a wall is again formed at the base of the trichogyne. "The nuclei are indistinguishable in size, structure and staining qualities, so that it is quite impossible to pick out a single nucleus at this stage and say with certainty whether it has come from the oogonium or antheridium originally. . . . The nuclei fuse in pairs . . . there seems no reason to doubt that such fusing pairs consist in all cases of male and female pronuclei from the antheridium and oogonium respectively." The ascogenous hyphae bud out from the ascogonium. These grow, the tip curves over and there two nuclei fuse to form the ascus nucleus. "The only nuclear divisions I have seen in the ascogenous hyphae of *Pyronema* are the simultaneous divisions in the hyphal tips." He found that the ascogenous hyphae produced numerous short branches but never found more than two asci arising from the one hypha. In the three successive divisions of the ascus nucleus there are twelve chromosomes present at each division.

Harper worked with material which was found growing naturally. Dangeard (1903 and 1907) published his results obtained by working with the fungus grown in pure cultures. He found that instead of three pairs of sexual organs being the average number for each fruit, by repeated dichotomies of the original branch sixteen pairs were theoretically possible. According to Dangeard the nuclei in the ascogonium grow in size and arrange themselves round the periphery; the nuclei will mass in the centre if the rosettes are immersed in water. The nuclei in the antheridium and trichogyne disorganise simultaneously. The wall at the base of the trichogyne does not disappear and reappear again as stated by Harper. The ascogenous hyphae are segmented into various lengths with numerous nuclei. The results obtained in studying the divisions in the ascus are peculiar. In the first division there are eight chromosomes; in the second and third divisions

only four chromosomes. This halving of the number of chromosomes in the second division he also found in *Ascobolus furfuraceus*. Fraser and Brooks (1909) confirmed Dangeard's account in the latter case and held that the phenomena indicated the occurrence of brachymeiosis.

Claussen published his preliminary paper in 1907. In 1909 Brown published a preliminary note on a form which agrees with the taxonomic description of *Pyronema confluens*. "The ascogonia . . . contain many more nuclei than the antheridia. The trichogyne and antheridium were never found to be connected and often not in contact, while the nuclei of the antheridium degenerate *in situ*. . . . No fusion of nuclei was found in either the ascogonia or the ascogenous hyphae, except in the cell which swells out to form the ascus. . . . An appearance quite like fusion but resulting from division was, however, found frequently in both the ascogonia and ascogenous hyphae. . . . The separation of the two nuclei gives an appearance very much like what Claussen has described . . . . as the separation of sexual nuclei, and the question arises as to whether the phenomena in both cases may not be due to division. . . . . At the tip of the ascogenous hyphae were found two nuclei which, when their origin could be determined, were formed by the division of a single one." The number of chromosomes in the divisions in the ascus are probably constantly five.

Claussen grew the fungus in pure cultures. He finds that the ascogonium and the antheridium arise from the same mycelium, i.e., that the fungus is homothallic. His description of how the sexual organs develop is similar to that of Dangeard. In the mature sexual organs Claussen finds nuclei of three sizes, largest in the ascogonium, smallest in the trichogyne, and of intermediate size in the antheridium. He was unable to make out whether any nuclear division took place in the sexual organs. The processes proceed at first as recorded by Harper but the female nuclei are not massed in the centre of the ascogonium but arranged round the periphery as Dangeard described. Certain nuclei, both in the antheridium and in the oogonium, degenerate before the sexual act. After the completion of the sexual act many nuclei were found associated in pairs in the ascogonia. Because of the slight difference in size of the nuclei and of their nucleoli he interprets these pairs as consisting of a male and a female nucleus. These nuclei do not fuse but pass out in pairs into the ascogenous hyphae, which structures were particularly studied both in *Pyronema* and in many other Ascomycetes. It is only very recently that special attention has begun to be paid to the ascogenous hyphae. Most observers have been perfectly contented if they have been

able to record the fusion of two nuclei in the penultimate cell and have usually disregarded any other feature or treated it as an abnormality. McCormick (*Helvella elastica* 1910) and Brown (*Leotia chlorocephala* 1910) were the first to definitely work out the variations in the growth of these hyphae. Claussen's work confirms and adds to what has been already done. The ascogenous hyphae may remain single or divide. In them the paired nuclei may divide by conjugate division. The hyphae become septate. The cells at the tip contain only one pair of nuclei but the lower cells may contain many pairs. Asci may develop from any of the cells. Two nuclei fuse to form the ascus nucleus. There are thus three stages in the fusion process; an association of male and female nucleus, a period of conjugate divisions and a nuclear fusion. It is easy to see how closely this corresponds with what takes place in such a group as the Uredineae. In the three divisions to form the nuclei of the spores the first two divisions are reduction divisions. In all three divisions there are twelve chromosomes present though the figures given of the last division are not very satisfactory. "Eine Brachymeiosis existiert nicht." The author does not take Dangeard's work into serious consideration. Concerning Brown's results he says "Ich kann Browns Beobachtigen nicht bestätigen. . . . . Sicher kann man sagen: Die drei von Brown publizierten Figuren sind keine Kernteilungsfiguren." Claussen studied the development of *Pyronema* because he considered that the alternation of generations had not been properly worked out in the Ascomycetes. Certainly, if two nuclear fusions take place in their life history, it is difficult to relate them up with the other plant groups. The attractiveness of Claussen's results is partly owing to the fact that he finds a binucleate stage regularly alternating with a uninucleate stage: the spore, mycelium and sexual organs are thus gametophytic whilst the ascogenous hyphae are sporophytic. Maire (1903) and Guilliermond (1904) found a series of binucleate cells in the ascogenous hyphae of *Galactinia succosa* and had considered that this might be related up to what occurs in the Uredineae.

Claussen (1905) had also worked at *Ascodesmis*, a genus closely related to *Pyronema*. In this study he recorded two nuclear fusions but he now considers these results "sind offenbar falsch." Dangeard (1903) worked at the same genus but found that the nuclei of the antheridium disorganised and never passed over into the ascogonium. Since the publication of Claussen's preliminary paper on *Pyronema* Schikorra has recorded similar phenomena in *Monascus*. But many previous workers (Barker, Ikeno, Kuyper, Olive, Dangeard) have studied *Monascus* and obtained very divergent re-

sults. It seems quite hopeless to try to reconcile the various results obtained in the study of *Pyronema.* We know from Van Tieghem's work that external conditions have some influence on the presence or absence of an antheridium. But this would hardly seem to account for the differences between the accounts given by Harper and Claussen. Concerning the rusts Harper* stated " Conjugate division may have arisen here, as it is perhaps beginning in *Pyronema*, immediately prior to a nuclear fusion in the spore-mother cell, and have worked backward through the sporophyte, thus tending to give more and more of a functional and sexual significance to the fusion in the spore mother-cell, until, finally reaching the fertilized egg, the fusion of the pronuclei disappeared." Lutman, a pupil of Harper, in his paper on the life history and cytology of the smuts gives forth a very similar idea, " That the sporophytic binucleated condition of the cells can work back in the mycelium has been recently shown by the work of Maire on *Galactinia succosa,* in which he found that the binucleated condition which was supposed to appear only in the ascus cell may appear in several cell generations back of it. Such a tendency might lead to a form with binucleated cells throughout its ascogenous hyphae and this condition might lead to the entire suppression of the original type of fertilisation such as occurs in *Pyronema, Sphaerotheca,* &c. . . . The old, normal fertilisation at the beginning of the sporophyte generation might thus become lost or suppressed." It seems an easy matter to guess what would have been the interpretation put upon such observations as those of Claussen, if the fungus studied had been other than *Pyronema confluens.*

The Pyrenomycetes are interesting as they show different types of sexual organs, but comparatively little cytological work has been done on the group considered within its proper systematic limits. Nicholls (1896) was the first to apply modern cytological methods. Her researches were occupied with *Teichospora* sp., *Teichosporella* sp., *Ceratostoma brevirostre* and *Hypocopra* sp. She found in *Hypocopra* and *Ceratostoma* a coiled multinucleate archicarp and usually a multinucleated male branch. These intertwined and their tips fused. As the male branch did not lose its protoplasmic contents the evidence pointed to parthenogenesis. In *Teichospora* a single cell of the mycelium by successive divisions and growth formed a solid sphere of parenchymatous tissue, certain interior cells of which enlarged and became differentiated into asci. In *Teichosporella* there is a similar arrangement but a

* Sexual Reproduction and the Organisation of the Nucleus in Certain Mildews, p. 87 (1905).

protuberance occurs in the region of the archicarp which by its shape and position suggests that it is a degenerate rudiment of an antheridium.

Dangeard (1907) worked at several of the group. He found that in *Chaetomium spirale, Sordaria fimicola, Hypocopra merdaria* and *Podospora hirsuta* the archicarp is a curved septate branch, in *Sordaria macrospora* a straight septate filament, and in *Sporormia intermedia* a mass of tissue somewhat similar to what Nicholls found in *Teichospora*. Dangeard considers that in no case is it possible to differentiate the antheridium from the enveloping vegetative hyphae. In *Chaetomium* and *Podospora* the cells were uninucleate; in the other cases multinucleate. Vallory (1911) worked on *Chaetomium* (see Trans. Brit. Mycol. Soc. 1912, p. 359).

Wolf (1912) has investigated the method of spore formation in *Podospora anserina*. The genus is interesting because of the variation in the number of functional spores in the different species. The species studied has four ascospores. "The perithecia arise from hyphal coils. The coiling of the two threads was observed both in living and in fixed material. The nuclei are so small, the filaments themselves being only 3μ in diameter, that none of the stages in fusion were observed. That this association of the two filaments represents the sexual process is however very probable. . A sphere of parenchymatous tissue develops from this coil. . . . The asci arise in a tuft . . . several being seen to branch from a single hypha. The cells of the perithecial wall, the filiform paraphyses and the vegetative mycelium are uninucleate." (This uninucleate condition was observed by Dangeard in *Podospora hirsuta*.) The processes of nuclear division in the ascus were not very clear, but the first two divisions, which probably constitute reduction divisions, follow one another rapidly. Then follows a short period of rest during which the nuclei grow somewhat. This rest period is emphasized and is stated to be probably common. It was also recorded by Brooks in *Gnomonia*. After the third division the nuclei remain in pairs close together. The details of the process of spore delimitation and the subsequent laying down of the spore membrane could not be made out. "The fact remains, however, that two nuclei are included within each of the spores formed, none of the eight nuclei disintegrating in the periplasm." This is in contrast with *Phyllactinia*, where Harper found as a rule eight free nuclei in the ascus, out of which only two developed, the rest disorganising. That this disintegration is not so universal as Harper assumed is shown by Dixon's account of the multinucleate ascopores of *Tuber aestivum*. "The nuclei formed in the ascus are large. . . . Round four or five of the nuclei, and

in close proximity to their membranes, the cell walls of the ascospores are developed."*

Wolf thinks that in *Podospora anserina* " judging from the fact that the nuclei always lie in the axis of the newly formed spore and near the lower end, it seems quite probable that only the lower one of each pair is concerned in the formation of the wall." The lower portion of the spore becomes the appendage. One nucleus at first lies within this end. As the spores increase in size there is a corresponding increase in the size of the nuclei which come to lie near the centre of the spore. In *Pleurage (Podospora) zygospora* (Lewis 1911) found that eight free nuclei were formed in the ascus, and from these, eight uninucleated sporogenous cells were formed. By the development of these cells and the division of the primary spore nucleus a multinucleated filamentous spore is formed which may, or may not, become divided up by septa into uninucleate portions. In the case of *P. anserina*, however, the spores are binucleated from the first and no subsequent nuclear division occurs up to the time the mature spore has been formed.

Another section of the group shows structures which usually have been interpreted as spermatia and trichogynes. Much phylogenetic interest is centred on this group of the Pyrenomycetes. The data used in the discussions are those obtained by the old morphological workers. Two of the species which were regarded as having a trichogyne constantly present are *Polystigma rubrum* and *Gnomonia erythrostoma*. Brooks (1910) working on the latter found that in all the cases he studied it was only possible to trace a connection between the trichogynes and the outermost cells of the ascogonial " coil " and that they could never be traced to any structures resembling ascogonia. He therefore considered them as " mere continuations of vegetative hyphae belonging to the 'coil.' " The spermatia were produced in large numbers and were frequently seen adhering to the gelatinous trichogynes but no definite evidence was obtained for the passing of spermatial nuclei down the trichogynes. The nuclei in the ascogonial cells become larger but this is owing to growth, no fusion of female nuclei having been seen. The ascogenous hyphae do not appear to develop from the ascogonium.

Blackman and Welsford (1912) studying *Polystigma rubrum* obtained very similar results to those of Brooks. This fungus had been worked at morphologically by Fisch (1882) and Frank (1883) who recorded the existence of well-marked, coiled multicellular ascogonia with trichogynes and also of

* H. H. Dixon. The possible function of the nucleolus in heredity. Ann. Bot. XIII., p. 277 (1899).

spermatia which were peculiarly curved and seemed adapted for catching on the trichogynes. Frank believed that he had obtained evidence of a fusion between spermatium and trichogyne indicating the occurrence of a normal sexual process. "It seemed then possible that a knowledge of the cytology of this form might throw considerable light on the general question of the sexuality of the Ascomycetes and of the Lichens in particular, for the problem which apparently faces us in the Lichens, that of fertilization by a spermatium of a *multicellular* ascogonium, has in no case been completely solved." These hopes were not realised. In the spermogonia, uninucleated spermatia are borne terminally on uninucleate hyphae. The nuclei of these hyphae are only slightly elongated but those of the spermatia are very long and narrow and appear at maturity as a narrow band staining nearly homogeneously and occupying the lower half or two-thirds of the cell. "The nucleus appears in many cases to undergo early disorganization, for it may show a nodulose appearance while the spermatia are still enclosed within the spermogonium. The spermatia are carried out of the spermogonium by a mucilaginous material which oozes from the mouth of that organ, and thus the spermatia become distributed over the surface of the leaf. No relation of any kind was observed between the spermatia and the female reproductive organs, and attempts to bring about the germination of the spermatia ended, like those of Fisch, in failure. The spermatia must, then, be considered *functionless* structures, like the similarly named structures in the Uredineae." "In the early stages of mycelial development the hyphae congregate, especially in the intercellular spaces beneath the stomata, *and often push their way through the stomatal pore.*" The ascogonia develop from the rapidly growing ends of ordinary hyphae: they were multinucleated in the earliest stages observed. Surrounding each ascogonium is a mass of small celled hyphae which have cells with one nucleus and slightly thickened walls. There is great variety in the length of the ascogonia and in the degree of coiling. The number and size of the ascogonial cells are very variable, but the majority are multinucleate containing about four nuclei. The base of the ascogonium can usually be traced into a vegetative hypha while the apex usually ends blindly some distance from the stoma in the neighbourhood of which the ascogonia are usually found. "In no case could the ascogonial hypha be followed through the stoma in the form of a specially differentiated trichogyne." The basal cell, which connects the ascogonium with the ordinary vegetative hyphae, is larger than the others and contains a large number of small nuclei. The nuclei usually show a chromatin network and a well-marked

nucleolus, but the nuclear membrane is not generally to be distinguished. "In a few of the cells of each ascogonium there is generally to be found—either alone or with other ordinary nuclei—a nucleus without a distinct chromatin network, but with a large nucleolus. The origin of these special nuclei could not be traced. No convincing evidence of fusion of ascogonial nuclei could be obtained, though the common close association of the nuclei in pairs and the difference in the size of the nuclei of a single cell suggest that such fusions may still take place in spite of the abortive nature of the ascogonia. . . . The cells of the ascogonia do not become emptied of their contents, as in the functional ascogonia of *Ascobolus, Humaria*, &c., but retain their contents during the process of disorganization and so appear as darkly staining masses." Though not in structural connection with the ascogonium the perithecium arises in its neighbourhood, one perithecium usually being found in association with each ascogonium. The perithecium is first distinguished as a group of special hyphae which arise from the small celled hyphae surrounding the ascogonium. The cells of these special hyphae "may have the nuclei arranged in pairs." During the early stages of development the disorganising cells of the ascogonium can be clearly seen at its periphery. Later the ascogenous hyphae become differentiated towards the base of the young perithecium. They have no connection with the ascogonia but arise by differentiation from the perithecial hyphae which are of vegetative origin. This vegetative origin of the ascogenous hyphae would seem to be common in the Pyrenomycetes: it also occurs in the Discomycetes (e.g. *Otidea aurantia*, Fraser and Welsford 1908). "If a section be taken through the base of the perithecium at a time when the ascogenous hyphae are differentiating there may be seen, besides the nuclei in pairs mentioned earlier, larger nuclei. Nuclei in close contact are also seen, and in one case what appeared to be a stage of nuclear fusion. . . . There are thus indications that at this stage a nuclear fusion occurs which replaces a normal sexual fusion now lost. The details of the formation of the asci and the ascospores were not followed, since for such work this form is not a favourable object, but a few stages were observed showing that the ascus is formed in the normal way with fusion of nuclei in the penultimate cell of an ascogenous hypha." The authors hold that "the evidence to be drawn from a study of *Polystigma*, though not very strong, gives no support to the contention of Claussen that there is only one nuclear fusion in the Ascomycetes, that in the ascus." The great theoretical interest of the paper would however seem to be that in a case where both male and female organs were supposed to be particularly well marked and where

special adaptations seemed to exist to ensure normal fertilisation, both are functionless. It seems unlikely that a normal process of fertilisation will be found in any of the nearly related Pyrenomycetes.

Arnaud (1912) has a short note " Sur la cytologie du *Capnodium meridionale* et du mycélium des Fumagines," an outcome of his systematic work on these leaf fungi. The mycelium in *Capnodium meridionale*, *Limacinia Citri*, *Cladosporium herbarum*, *Alternaria tenuis* and *Dematium pullulans* is formed of septate filaments, the cellular cavities being in communication by means of fine canals. When two filaments meet they anastomose in general by a similar canal. In the stromas, all the cells are often anastomosed into a network. The cells are uninucleate except in *Dematium pullulans*, where they are multinucleate. In *Capnodium meridionale (Limacinia Citri* and probably the other members of the group) " la masse générale des conceptacles a une origin indépendante de la sexualité: pycnides et périthèces sont homologues au début. L' ascogone se montre dans un stroma ayant presque le volume du périthèce definitif. On trouve parfois autour des cellules derivées de l'ascogone des filaments analogues aux pseudo-trichogynes signalés chez divers Ascomycètes *(Collema, Polystigma)*; ces filaments septés n'ont, semble-t-il, aucune signification au point de vue de la reproduction." The development of the ascogenous hyphae was not followed, nor was the fusion of nuclei in them, to form the primary nucleus of the ascus, observed. The nuclei have a nuclear membrane and a nucleolus. The account of the division of the ascus nucleus seems rather out of date. The analogies are supposed to be with what Harper described in the Erysiphaceae and Maire in the Basidiomycetes. Some figures appear to indicate that the figure is double at the beginning and analogous to the two chromosomes of the Uredineae (Sappin-Trouffy) and that the nucleolus disintegrates at one extremity of the spindle furnishing it perhaps with a portion of its chromatin. The spindle is very well defined at the equatorial plate stage; it stains strongly especially at the two extremities (? centrosomes) which appear bilobed and present radiating striations (aster) of which two are more marked. The chromosomes are small and four in number. Their division is not simultaneous. " *Capnodium meridionale* se distingue, au point de vue cytologique, par l'etroitesse et la colorabilité du fuseau de division; le nombre de chromosomes, quatre, est celui qui est indiqué par plusiers auteurs comme étant le nombre habituel chez les Ascomycètes." In the ascospores septation follows nuclear division, the septate spores being formed of uninucleate cells. The point of interest in the paper concerns the trichogyne. It must be said that such a de-

scription of nuclear division in the ascus adds nothing to our knowledge. Two chromosomes in the Uredineae and four chromosomes in the Ascomycetes savour of very antiquated cytological ideas.

Faull (1912) follows up his preliminary paper of last year by presenting the results of his studies on *Laboulbenia chaetophora* and *L. Gyrinidarum*. The group as a whole is such an interesting one that a cytological investigation of any of its members has been awaited with eagerness. The author introduces his paper by stating that "The Laboulbeniales possess many fundamentally important morphological features that cannot be properly interpreted until their underlying cytological phenomena have been elucidated. This is especially true of their organs of reproduction, including both gametangia and spore-sacs. Thus the latter have been rightly denominated asci by some botanists, but in the absence of any knowledge of their cytology—which recent investigations have shown to be essential to a definition of the ascus—others have advanced different views with regard to their nature, and correspondingly different speculations as to the taxonomic position of the group. By way of illustration . . . . Engler's Syllabus . . . . [classifies them] as Laboulbeniomycetes, a class of equal rank with the Ascomycetes and the Basidiomycetes. The gametangia have played an even more prominent part in these speculations. This is particularly true of the female organ, whose striking resemblance to that of the red seaweeds has won for it the name of 'procarp,' and given rise to the theory that the Ascomycetes are an offshoot of the Florideae with the Laboulbeniales as the connecting link. But every biologist nowadays realizes the unreliability of schemes of phylogeny, the sole capital of which is external morphology. . . . Because [the sexual organs] are well marked and apparently functional they have been cited as proof that the Ascomycetes have not parted with their sexuality. As a matter of fact, it has never been shown whether they are or are not sexually functional or just how they may function."

L. chaetophora and *L. gyrinidarum* are, as far as is known, forms which do not possess antheridia. Hence it is apparent there cannot be normal fertilisation. Faull's preliminary note suggested that even where there were well marked spermatia these were not functional. What we now want is a full account of the cytological phenomena in one of the group where there is an antheridium and particularly in a case such as *Zodiomyces*, where the trichogyne is described as growing down at first towards the antheridium, receiving the antherozoid on its tip and then growing back apparently into its more normal position.

In the cases studied the entire plant is enclosed by a thin, homogeneous, extremely tough and impermeable, continuous membrane which is independent of the cells of the thallus. The wall immediately underlying this is a remarkably thick wall of from two to five layers, which exhibits a curious differentiation expressed both by structural peculiarities and characteristic reactions to staining media. The walls of the trichogyne, the appendages and the inner walls of the perithecium are comparatively thin. Possibly the most interesting features of the septa are the pits. Faull could not satisfy himself as to the existence of uninterrupted protoplasmic bridges. The middle lamella stretches across the bottom of the pits and there is considerable doubt as to the extent to which it is perforated. " In a few instances, but very few, I have found a coarse strand of protoplasm, differing in no way from the cytoplasm of the protoplasts, passing from cell to cell, but these are undoubtedly exceptional phenomena. . . . In favourable preparations the middle lamella . . . can be seen to be perforated by a very fine pore, and in some instances there is the appearance of several minute perforations. But there are no large openings."

The protoplasts are typically monoergid, each cell possessing a single, relatively large nucleus. Occasionally in older plants the nucleus of some of the cells may undergo one, or more, divisions. The somatic nuclei are characterised by a large nucleolus and discrete masses of chromatin. " There is no reason for believing that any portion of the chromatin is held by the nucleolus, for it is readily distinguishable in the resting nuclei in well-fixed preparations." The cytoplasm is finely granular or reticulate but usually in the larger cells it is of a coarse spongy or reticulate structure. The procarp has its origin as a uninucleate terminal cell of a lateral branch of the receptacle. The mature procarp consists of three parts, the carpogonium, the trichophoric cell and an elaborately branched, frequently septated trichogyne consisting of uninucleate cells. The trichophoric cell is uninucleate and when first formed the carpogenic cell contains only one nucleus. This latter is succeeded by a pair of smaller nuclei, but its actual division has not been observed. The nucleus of the trichophoric cell very soon moves down next to the carpogonium and undergoes a homotypic mitosis. The number of chromosomes could not definitely be made out. " At this stage, or even earlier, the partition separating the two cells disappear." Two transverse septa now form, one between the daughters of the trichophoric nucleus and the other between the two nuclei in the carpogonium. Thus we have a restored trichophoric cell and an inferior supporting cell formed. The two nuclei in the middle cell grow for a short period and then divide. Their division

is immediately followed by the cutting off of the superior supporting cell which receives two of the four daughters, the other two remaining in what is now the ascogonium. The two nuclei left in the ascogonium again divide and a secondary [inferior] supporting cell is cut off which likewise appears to be characteristically binucleate. The remnant of the ascogonium is still binucleate and it may at once begin to bud off asci, or, as usually happens, first divide into two binucleate ascogenic cells. Thus we have a restored trichophoric cell, a superior supporting cell, then the ascogonium, followed by one or two inferior supporting cells. The supporting cells soon begin to break down: thus the ascogenic cells with their asci come to lie free in the cavity of the perithecium, where they are sustained by the cells lining the perithecium. The latter are thin-walled and well nourished. " A general survey of the Laboulbeniales reveals the fact that the procarp is characterized throughout by the constant occurrence of two cells, the carpogonium and the trichophoric cell. There is always a trichogyne, but it is extremely variable. The trichophoric cell is of especial interest since it is not represented in the Florideae or the Uredineae, and, if represented, is not determinable in any other Ascomycetes. Whether it is to be looked upon as a part of the trichogyne or as a part of a two-celled 'scolecite,' its history and functions call for closer scrutiny. In the apogamous species investigated in this paper its nucleus joins forces with that of the carpogonium, a phenomenon quite comparable, without any thought of implying homology, to the initial stages of fertilization in certain Uredineae and possibly in such sac-fungi as *Ascobolus*." The ascogenic cells are binucleate at all stages. The rather large nuclei divide simultaneously prior to the formation of each ascus. This is a conjugate division: one of the daughters of each of the mother nuclei passes into the young ascus and the other remains in the ascogenic cell. The pair left in the ascogenic cell immediately begin to increase in size, and with the advent of the next ascus undergo another division. The divisions of the nuclei are homotypic and the chromosomes four in number. The ascogenic cells of the Laboulbeniaceae have seemed to be unique among the Ascomycetes in respect to the limited and constant number for each species, and in respect to their capacity for giving origin to an unlimited number of asci. The number of ascogenic cells in *Amorphomyces* is one, in *Laboulbenia* two, in *Stigmatomyces* four, in *Haplomyces* eight, and in *Polyascomyces* thirty-two or more. " This fixity of number is paralleled, however, by such genera as *Sphaerotheca*, in which there is a single ascogenic cell in every fruiting body, and as to the unlimited capacity of the ascogenic cells

for ascus production I have found examples not at all uncommon in practically every order. The cytological details in these examples correspond to those in *Laboulbenia* in that a series of conjugate divisions takes place in the ascogenic cell in relation to a corresponding budding off of asci." That the nuclei of a potenial ascogenic cell may undergo many conjugate divisions, and eventually give rise to many asci is undoubtedly a character of the Ascomycetes, as the work of McCubbin, Brown and Claussen also shows. In *Laboulbenia* the apparatus involved is extremely simple, since the ascogenous cells correspond to the entire system of ascogenous hyphae and part of the female apparatus in most other groups. They are characterised by a similar series of conjugate divisions, but undergo no considerable growth, no branching and no septation.

The spores of the Laboulbeniales are invariably borne in sacs, constantly to the number of four, or in a few species of eight. The asci begin " as basipetally arranged folds or outgrowths of the ascogenous cells. They are never septated off from the latter, but their bases, which at first are very broad, gradually contract until finally the protoplasmic connexion is broken." The ascus, which is small at first, grows to a relatively large size. The definitive nucleus increases enormously in bulk. " Two nuclei which we may with good reason assume to be lineal descendants of the pair that occupied the carpogonium in its later stages of development enter the young ascus and fuse with one another." In the first division of the nucleus there is a synaptic stage and also " what may possibly be interpreted as a second contraction." The first spindle is clearly intranuclear and is terminated at both ends by an extranuclear disc-shaped central body. There are four elongated and curved chromosomes of unusual size for a fungus. The second mitosis follows very swiftly on the heels of the first. The division is homotypic. In the last mitosis " it was not possible to determine just how the chromosomes divide, but they do divide, and there is no reduction in their number." The spores are delimited " by the differentiation of a limiting layer of hyaline or finely granular layer of protoplasm that begins adjacent to the centrosome and continues progressively until completed at the opposite pole " as has already been described by the author (Faull 1905). " It is possible to state with almost absolute certainty that the lower daughter nucleus of each spindle functions as a spore former. . . . The upper daughter nuclei, on the other hand, initiate no spores and pass at once to the upper end of the ascus, where they eventually disintegrate." The nucleus divides in the spore (four chromosomes being present) and a thin septum is quickly formed between the daughter nuclei. The author concludes that the

Laboulbeniales are true Ascomycetes, this conclusion being reached from a consideration of the spore sac, " the only positive diagnostic feature that distinguishes the Ascomycetes from the other higher fungi," and that in accordance with prevailing definitions they are " a suborder of the Pyrenomycetes."

It would seem that Faull's observations accord very well with those of Claussen on *Pyronema.* In each case there is no fusion in the ascogonium but a series of conjugate divisions arise, two nuclei ultimately fusing to form the definitive nucleus of the ascus. An ineffective trichogyne recalls the work of Brooks on *Gnomonia*, and Blackman and Welsford on *Polystigma.*

Rawitscher (1912) has studied certain points in the life history of Ustilagineae. This order can be most conveniently divided into the Ustilaginaceae, where the entire group of hyphae breaks up into spores and the Tilletiaceae where the spores are borne as side branches, or at the tip of the main hyphal branches. Most of our information concerns the Tilletiaceae. Dangeard (1894) was the first to give any definite knowledge concerning the nuclear phenomena. The fusion of two nuclei in the formation of resting spores has been recorded in *Doassansia Alismatis*, *Entyloma Glaucii* and *Urocystis Violae* (?) by Dangeard, in *Doassansia Alismatis*, *D. deformans*, *Urocystis Anemones* and *Entyloma Nymphaeae* by Lutman (1910), in *Tilletia Tritici* by Maire (1902) and in *Entyloma Nymphaeae* by Raciborski. Dangeard, Fisch and Schintz stated that the mycelium that produced these spores was multinucleate; Lutman held that it was binucleate.

In the Ustilagineae, Dangeard found a fusion of two nuclei in the resting spores of *Ustilago Tragopogi* and thought it took place in *U. Violacea.* Lutman's observations indicated that such a fusion occurs in the young spores of *U. levis* and *U. Zeae.* He thought that in these species the cells of the mycelium were multinucleated.

When the resting spores of the Ustilagineae germinate they form a promycelium which buds off conidia. The process of conidial formation differs in the different genera and even in different species of the same genus. When the promycelial cells or conidia are brought under certain conditions they fuse. In *Ustilago Tragopogi* according to Federley (1903) the nuclei of the fused conidia travel towards one another and apparently fuse as a rule. In the promycelial cells of *Ustilago Hordei*, *U. Avenae* and *U. Tritici*, according to Lutman, the nuclei travel towards each other, come to lie in the same cell and apparently fuse. In *U. antherarum*, as described by Harper (1899), the nucleus of each conidium remains in its place and all that occurs between the conidia is a cytoplasmic fusion. This last result recalls what Dangeard found in

Tilletia Tritici, where the cytoplasmic fusion of the conidia is never followed by a nuclear one.

Working with *Ustilago Tragopogonis*, Rawitscher found that sections of the young flower show intercellular, isolated hyphae which eventually produce a thick tissue of small cells. All the space in the bud becomes full of hyphae but the cells of the host plant are not attacked. The fungus mycelium is enveloped in a gelatinous layer which binds the separate hyphae together. The spores are formed by the breaking up of the hyphae into small portions which are at first angular but become rounded off and grow. The young spores are at first binucleate. Before the spores have attained their full size, the nuclei approach and fuse. All the cells of the hyphae were binucleate. How this binucleate condition arose the research did not show. In the germination of the spores, a three-to-four-celled promycelium is produced. The cells are uninucleate and detach from their ends many uninucleate sporidia in succession which increase by lateral budding but always remain uninucleate. As the spores soon lost their capacity for germination, copulation studies and infection experiments could not be carried out.

In *Ustilago Maydis* the author found that the germinating spores built short mycelial tubes which fell apart into separate uninucleate cells. These produced uninucleate sporidia. The description adds nothing to what Harper described. The sporidia increase in large numbers by sprouting but they neither copulate nor build a true mycelium, although under certain conditions they may hang together in chains. When maize plants were inoculated with the sporidia their intercellular spaces became infested with a strong-growing uninucleate mycelium which applied itself closely to the cell walls of the host. The gelatinous envelope is at this time feebly developed. The hyphae branch and separate up into small uninucleated portions. (Owing to the gelatinous envelope which has increased by this stage, taking up some stains strongly, the walls are difficult to see. Thus the author accounts for Lutman describing the cells as many nucleate). The hyphal cells by rapid division form a nest, the uninucleate portions being dispersed through a gelatinous mass. Two hyphal cells are often seen lying end to end. The wall separating the two cells becomes thin and finally disappears. Both nuclei move to the middle of the copulation cell structure, which portion becomes larger while the end portions of the figure become poorer in cell contents. In this way the binucleate condition arises. From these cells, by division, binucleate portions arise which round themselves off and become spores. The nuclei approach but owing to their

smallness the fusion cannot be closely followed. It seems to proceed very quickly while the young spore cells are still small. The larger spore cells are almost all uninucleate. In this fungus we have therefore a binucleate condition arising just previous to spore formation which alternates with a uninucleate condition arising in the spore.

Rawitscher also worked with *Ustilago Carbo*. The spores retain their germinative capacity for a long time and are always easy to germinate in slightly nutrient solutions. The germination is similar to that in *U. Tragopogonis*, but there is a strong tendency to copulation under favourable conditions. The production of branching mycelia is more common than that of sporidia formation in nutrient media. Copulation between neighbouring cells with the production of buckle-shaped cells of the appearance known since the time of Tulasne is exceedingly common, so much so, that in an appropriate preparation it is hard to find an uncopulated cell. As Brefeld has already realised the fusions are not limited to neighbouring cells: they may occur between the cells of different promycelia. When the spore germinates the nucleus divides. One of the daughter nuclei wanders into the tube while the other remains behind in the spore. It is possible for the spore by the repetition of this process to form, one or many, additional promycelia. Especially frequent is the case (previously observed) where a second promycelium grows along the cells of the first and fuses with one of these, usually the end one. When sporidia are produced these are seen to fuse not only with one another but also with the promycelial cells: but never more than two cells were observed to copulate. The author holds tnat this copulation is not a vegetative phenomenon. The nucleus from one cell wanders into the other but the two nuclei remain separate. The process is easiest to follow when two neighbouring cells of the promycelium fuse. Each puts out a process near the separating cross wall. The processes lie close together but only touch at their ends. Here the walls disappear and the plasmas meet. The nuclei of both cells may approach the connection but the nucleus of one cell passes through the connection into the other cell. The passage of the nucleus completed, the contents of the non-nucleated cell pass over into the other as Lutman and Federley suggested. Eventually only binucleate cells are present. These grow and produce a binucleate mycelium. In the host plant the hyphal cells which are proportionately large and show clearly two nuclei, eventually begin to branch and fall apart into small portions forming a nest of hyphae surrounded by a gelatinous layer. As in *U. Tragopogonis* these portions break up until very small, irregular, angular cells are formed. These

cells are, however, so small that the binucleate condition is difficult to observe. The fusion of the nuclei was not observed but it must take place as the ripe spores contain only one nucleus. In this fungus the greater portion of the life history is binucleate: only the ripe spore and the first divisions are uninucleate.

Judging from the results obtained by Rawitscher it would seem that the binucleate condition can arise at different stages in the life history. In *Ustilago Maydis* the uninucleate condition is predominant, while in *U. Carbo* it plays a very inconspicuous part in the life history. This indefiniteness of the place of origin of the association of two nuclei reminds one of the similar state of affairs in the Basidiomycetes.

Werth and Ludwigs (1912) have studied spore formation in the rusts and smuts. The question which they set themselves was to find out whether the brand spores of the Ustilagineae and the uredospores, teleutospores and aecidiospores were homologous and also whether the promycelium of the Ustilagineae was homologous with that of the Uredineae. They state that although the Ustilagineae and Uredineae are always placed together in classification no cytological proof of the homology of their several structures has been given.

Ustilago antherarum was studied. The ripe spore contains one nucleus with an excentric nucleolus. When the spore germinates the nucleus divides. One nucleus passes over into the promycelium while the other remains behind in the spore and may give rise to a second promycelium. (This is in agreement with what Rawitscher observed in *U. Carbo.*) The nucleus in the promycelium grows and then divides, and a septum is formed between the two nuclei. Now, or later, the promycelium separates from the spore. The upper nucleus usually divides and a wall is laid down between the daughter nuclei; the lower nucleus, as a rule, remains undivided. Hence there are usually three promycelial cells. In sporidial formation the nuclei behave as they do in the spore, i.e., they divide and one nucleus passes into the sporidium, the other remaining behind to provide for further sporidial formation. When the sporidia have fallen they bud off secondary sporidia. The nuclear process is again the same, one daughter nucleus remaining behind to repeat the process. Fusion between the fallen conidia is not rare. "Es findet dabei aber weder eine Verschmelzung, noch überhaupt ein Ubertritt des Kernes der einen Conidie in die andere statt." The youngest spores found were uninucleate, although they were at a very early stage. This is contrary to what the other investigators have observed in both the Ustilaginaceae and the Tilletiaceae.

They also undertook the study of *Puccinia Malvacearum*, a

form which, since it possesses only teleutospores, the authors regard as being directly comparable with the Ustilagineae.

Blackman and Fraser (1906) had previously investigated this fungus:—The vegetative mycelium is uninucleate. At the base of the teleutosorus a binucleate condition arises. Very careful research failed to reveal the exact method by which the transition from the single to the conjugate nuclear condition is brought about. The smallness of the cells and nuclei and the absence of any regular row or group of cells, such as are formed in the aecidia, on which attention could be concentrated, " render the task of elucidating the point almost hopeless." That the change of nuclear condition takes place at several different points in each sorus and not once for all is indicated by the general distribution of the binucleate hyphae which first appear.

Werth and Ludwigs found that the hyphae of the fungus in the intercellular spaces of the host branch and grow forming a thick pseudoparenchymatous tissue. From this clavate, strongly swollen, mycelial branches proceed radially towards the base of the leaf. Surrounding these hyphae is a pseudoparenchymatous tissue of seven or eight layers. The clavate cells are uninucleate at first but only for a short period. The cells are seen to be arranged in pairs. One of the cells is larger than the other and has a more swollen apex. Part of the wall between the two is broken down and the nucleus from the smaller cell passes over into the larger one, its track being shown by the clear zone which it leaves in the granular protoplasm. The two nuclei now divide by conjugate division. Several cells are formed, the upper two of which become the teleutospore, the lower ones the stalk. The nuclei fuse very late in the teleutospore, usually when the spore is quite ripe. In promycelium formation the nucleus undergoes two successive divisions and the septa are then formed between the nuclei. When the sporidia are formed the nuclei pass out into them without previously dividing. The case is thus different from that of the Ustilagineae, but the authors hold that the gap between the two is bridged across by such a form as that of *Endophyllum*, where the nucleus divides before entering the sporidium.

It is interesting to find recorded in this lepto-form, that the binucleate condition at the base of the teleutosorus does not arise by the fusion of two approximately equal gametes and also that the nucleus of the smaller cell always wanders into the larger cell. This is apparently the first record of such a case.

Sharp (1911) has published a preliminary notice on *Puccinia Podophylli*. A binucleate condition prevails in the mycelium

that gives rise to aecidia and spermogonia. The nuclei, even before there is any indication of aecidium formation, are associated in pairs and divide conjugately. This condition is not constant, however, as a uninucleated mycelium is sometimes observed. The young aecidium arises in a dense tangle of hyphae beneath the epidermis of the host. Certain cells in this tangle enlarge and become "basal cells," giving rise to aecidiospore chains of the usual type but containing two, three, or four nuclei, according to the number of nuclei present in the basal cell. In older chains only two of these basal cell nuclei continue to function, so that binucleate spores usually far outnumber the others. It is not known how the basal cells arise. Spermatia formation has also been studied. Two facts recorded by the author with regard to the spermatia are very interesting in connection with the generally accepted view that the spermatia are degenerate male cells, viz.:—1, the spermatia are sometimes binucleate; 2, "the spermatia vary in length, some of them being more than three times as long as the diameter of the nucleus, so that they contain much besides nuclear material." This is very different from the usual case, where the spermatia are uninucleate, the nucleus occupying practically the whole of the cell. The binucleate condition of the mycelium before aecidium formation suggests that we may possibly have in this fungus a binucleate condition throughout the life history, the opposite phenomenon from that observed by Moreau in an *Aecidium* on *Euphorbia silvatica*, where there was recorded a uninucleate condition in mycelium and aecidiospore.* The great variation observed:—large basal cells with three or four nuclei, presence at times of an uninucleate mycelium, and also the occurrence of tri- and tetra-nucleate aecidiospore, militates against this view. Until the author's complete account is published, we cannot decide as to the interpretation to be given to such an apparently abnormal case.

Fromme (1912) has worked at *Melampsora Lini*, which is an autoecious eu-form (it possesses spermatia, uredospores, teleutospores and aecidiospores all occurring on the same host). The aecidium is of the Caeoma type, i.e., there is no definite peridium. The spermogonia are usually flask-shaped, but sometimes there is merely a diffuse layer of spermatiophores without a definite flask-like structure. "The spermatiophores from which the spermatia are abstricted arise from large rectangular cells which are arranged in a regular series at the base of the spermogonium. The spermatiophores differ from those described by Blackman in that they are divided into a number of uninucleated cells, usually four, each of which puts out a fingerlike process from its upper end on the tip of which a

* *cf.* Transactions Brit. Mycol. Soc., p. 363 (1912).

single spermatium is produced. . . . The single nucleus divides successively to form the nuclei for a number of spermatia which are abstricted from the fingerlike tip of the spermatiophore. . . This seems to indicate that two or more generations of sporidia are produced from the same cell of the spermatiophore." The aecidium arises from a uninucleate mycelium which in the vegetative condition cannot be distinguished in any way from that which produces spermogonia. The nuclei are rather small but exhibit a clearly defined network and a definite nucleolus. After a period of vegetative development the filaments grow up between the cells of the mesophyll and reach the epidermis where they branch laterally to form a weft of hyphae. The branches next push up vertically and form a sort of palisade of large cells which contain very large nuclei and more compact cytoplasm than the ordinary vegetative cells. Each of these cells now divides somewhat unequally producing a smaller cell above, which again divides. Thus we have two smaller cells superposed upon a larger cell (the gamete). The sorus develops in a more or less centrifugal manner. Fromme considers the sterile cells as " buffer " cells, their function being to protect the gametes from the pressure of the epidermis: they degenerate to provide for the subsequent development of the gametes. Blackman and Fraser (1906) occasionally found a double layer of short crushed cells lying above the fused cells in *Melampsora Rostrupii*, but owing to the age of their material did not note the method of their formation. It is possible that the Melampsorae develop their gametes at a deeper point in the sorus than do the more superficial caeomata of the *Phragmidium* type. According to Fromme the frequent intimate association between spermogonia and aecidia is an interesting feature in this rust: the former appear somewhat earlier than the latter, but they are often found developing simultaneously and intimately associated, whereas in most rusts the spermogonium usually precedes the aecidium in the time of development by a period of several days or weeks. Their development proceeds simultaneously, spermatia and aecidiospores being formed at the same time and they are often found lying in the same cavity under the epidermis. " One of the difficulties in assuming that the spermatia are male cells has been the inaccessibility of the cells of the aecidium to fertilization by them and the production of the spermatia prior to the development of the aecidium. Here we have a case, however, where the two develop at the same time, and so near together that fertilization might easily be accomplished."

The large vertical cells of the aecidium now begin to conjugate in pairs. This conjugation is brought about by an absorption of the intervening cell walls at the area of contact.

The upper portions of the cells involved are usually in contact so that the absorption takes place in that region. The lower portions of the cell walls are usually not absorbed and the fusion cells formed remain with a conspicuous two-legged base. At the time of fusion the cytoplasm of the gametes is quite dense and stains readily. Sometimes the tips of the gametes converge and the point of contact and absorption is at the centre. The area absorbed may be of varying diameters but the passage of a nucleus through an imperceptible pore has never been observed in the case of the true fertilisations. The fusing gametes do not always lie side by side at the same level in the sorus. They may meet at various angles and frequently one of them lies somewhat below the other. " I do not believe, however, that in *Melampsora Lini* this indicates a difference in the time of development of the gametes, as Olive finds for *Triphragmium Ulmariae*." The irregularities due to the loose indefinite nature of the caeoma quite fully account for the unequal positions of the gametes. The abundance of sexual fusions in *M. Lini* is most striking, some sections showing practically every pair of gametes in the sorus in some stage of fusion. These stages are so abundant that there can remain no doubt whatever that the binucleated condition is, in this form, always instituted by means of a cell fusion between equivalent gametes. In some cases the nucleus of one gamete passes into the other and the gamete which is now binucleate elongates and functions directly as the " basal cell," as described by Olive for *Triphragmium Ulmariae*. In comparatively frequent cases there was a fusion of three gametes instead of two. Sometimes two cells in the same filament fuse with a single cell of the adjoining filament. This differs from the usual type of triple fusion in that two of the gametes come from the same filament. " It seems, then, that not only a single layer of cells are produced, in this form, but occasionally another cell placed below the ordinary functional cell also has the capacity for effecting fertilisation." Cell fusions between four gametes were very occasionally seen. Still more striking are the large multinucleated spore mother cells which are occasionally found in the aecidium. The figures probably resulted from the fusion of four gametes and the division of the nuclei. (cf. Olive, *Puccinia Circii-lanceolati*). In the uredosori the paraphyses are binucleate when young. This suggests that they have common origin with the functional uredospores.

There is thus present in *Melampsora Lini* a fusion of two equal gametes (Christman's method) as was also found by Blackman and Fraser in *M. Rostrupii*. A few cases of migration of nuclei were seen. " It does not seem possible to con-

nect any of these cases with the normal process of fertilization in any way, and the interpretation of Christman, Olive and Kurssanow of similar phenomena as 'pathological' seems most natural. . . . While the area of absorption between two gametes may be small at first and later broaden, as Olive has shown, there still remains a considerable difference between the passage of a nucleus as a fine thread through an extremely small pore, which cannot be seen before or after the passage, and the passage of a nucleus through a rather small pore which later broadens to permit the entire contents of the two cells to fuse." The author thinks the idea that the Uredineae are derived from the red algae is perhaps the most plausible view of the origin of the group: but he does not suggest that the superposed sterile cells may be the remnant of a septate trichogyne.

In the Basidiomycetes Fries has worked at *Hygrophorus conicus f. sulphurea.* In this group the work of several authors has shown that the young basidium is usually binucleate, the two nuclei arising by conjugate division although the history of these nuclei is not clearly known. The two nuclei in the basidium fuse; the fusion nucleus increases in size and then undergoes two divisions which resemble the reduction divisions observed in many plants. The four resulting nuclei pass into the spores. Species with only two spores have been studied (*Dacryomyces* spp., *Amanita bisporigera*, &c.) but in these cases there have been observed a nuclear fusion and two successive divisions, two of the nuclei passing into the spores, the other two remaining in the basidium. It is true that Dangeard thinks there is only one division, and that an indirect one, in the case of *Dacryomyces deliquescens*, but Istvánffi, Juel and Maire believe that there are the usual divisions in this genus. Maire holds that in this species there is a second crop of spores which utilise the second pair of nuclei, but from Buller's work on the morphology of basidia this seems very unlikely.

Maire (1902) had previously worked at *Hygrophorus conicus* and *H. ceraceus.* He found the cells of the subhymenium and the young basidia constantly uninucleate.* He founded a new genus, *Godfrinia*, for the reception of these species which he diagnoses as characterised "surtout par ses basidies ventrues et constamment bisporiques, uninucléées a l'état jeune, ainsi que les cellules du subhyménium."

Fries' work confirms that of Maire with regard to *H. conicus.* The cells of the trama contain one or more pairs of nuclei, while the cells of the subhymenium have only a single nucleus, each having a conspicuous nucleolus and two distinct masses

* Mr. Carleton Rea informs me that the red form of *H. conicus* in England always possesses four sterigmata and four spores.

of chromatin. The basidia from their inception are uninucleated. The nuclei have the same double nature of chromatin content. As the basidium enlarges there is a corresponding growth in the size of the nucleus which wanders to the point of the basidium. The chromatin becomes arranged in a long delicate spireme thread. Soon after this there is a disappearance of the nuclear membrane and the spireme suddenly contracts into a compact mass surrounded by a granular protoplasm. The spindle fibres now appear but no centrosomes were found. Two chromosomes pass to each pole. (This Maire also found, but he recorded here, as in all the cases he studied, the presence of what he terms protochromosomes.) The daughter nuclei are fully reconstructed and then wander towards the base of the basidium, while the sterigmata are developed. As soon as the sterigmata are fully formed the nuclei usually become beaked and pass into the spore beginnings. Here the nuclei divide either immediately (the division sometimes beginning in the basidium) or somewhat later; so that the kidney-shaped spore when it falls always possesses two nuclei. The author concludes that there are no reduction divisions in this fungus,, and that the reduced number of chromosomes holds right through the life history, i.e., that the diploid phase is wanting. There is thus a state of apogamy of the kind which Guilliermond has termed 'apomixie.'

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NEW OR RARE MICROFUNGI.

By A. Lorrain Smith, F.L.S., and J. Ramsbottom, B.A.

We are again indebted to Mr. D. A. Boyd for the very interesting material sent to us for examination, which included new species as well as many new to Britain. The lines of research —soil and bee-hive—undertaken by Miss Dale and Miss Betts have furnished other interesting microfungi which are described by the authors in their publications. Mr. Grove has also written diagnoses of the species recorded by him. In these cases it has been considered necessary to give references only.

PHYCOMYCETES.

SAPROLEGNIACEAE.

OSTRACOBLABE Born & Flah. in Bull. Soc. Bot. Fr. XXXVI., p. CL. (1889).

Thallus hyaline; hyphae slender, straight, uniform, non-septate.

O. implexa Born & Flah. Jour. cit. p. CLXXI. t. 12, figs. 1-6.

Species inhabiting the shells of oysters, &c.; hyphae straight or slightly flexuous, extremely slender, irregularly branched, about 1·5 to 2·5μ thick, with here and there fusiform swellings 3-5μ thick or more rarely globular and 8-12μ diam.

On various dead shells. C. Rea and H. C. Hawley in Proc. Roy. Irish Acad. XXXI. pt. 13 p. 5 (1912).

CHYTRIDIACEAE.

Synchytrium Succisae De Bary and Woron. Bev. Naturf. Ges. Freiburg. III. p. 25 (1863).

Warts yellowish, solitary or aggregate in brown crusts, roundish, projecting about 1 mm. above the leaf surface. Sporangial sori globose, solitary in the upper half of the swollen host-cell, 100-170μ in diameter. Sporangia 100-150 in a sorus, variable in form and size, 25μ in diameter, with thick, colourless membrane and vermilion-red, granular contents. Zoospores roundish 2-3μ in diameter, with one cilium, the contents colourless with red guttulae. Resting-spores either in ordinary epidermis cells, or, more frequently, in the epidermis

cells of the sorus warts, usually several in each cell, globose or shortly ellipsoid 50-80μ in diameter, with colourless endospore, and a thick smooth brown exospore and clear-orange contents. Germination unknown.

On leaves of *Scabiosa Succisa*, Lennie Woods Drumnadrochit (Trans. Myc. Soc. III., p. 52 (1909)), more recently by J. Adams at Leixlip Station, Kildare. Irish Naturalist XXI. p. 112 (1912).

PERONOSPORACEAE.

Peronospora Alsinearum Casp. in Monatsb. Berl. Akad. p. 330 (1855).

On *Spergula arvensis* and *Stellaria media.* Oospores abundant in early autumn.

W. B. Grove in Journ. Bot. L., p. 54.

P. Potentillae de Bary in Ann. Sci. Nat. 4 Ser. XX. p. 124 (1863).

On leaves of *Potentilla Fragariastrum* and *Sanguisorba officinalis*, Warwickshire, autumn.

W. B. Grove l.c.

P. alta Fück. Symb. Mycol. p. 71 (1863).

On *Plantago major*, King's Norton, July and August.

W. B. Grove l.c.

MUCORACEAE.

Mucor rufescens Fisch. in Raben. Krypt. Fl. p. 192 (1892). (?=*M. rubens* Vuill. in Bull. Soc. Mycol. Fr. III. p. 111 (1887)).

On cultures of sandy soil, Woburn. E. Dale in Ann. Mycol. X., p. 455 (1912).

M. Ramannianus A. Moell. in Zeit. Fort. Jagdw. XXXV. p. 330 (1903).

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M. circinelloides van Tiegh. in Ann. Sci. Nat. I., p. 94 (1875).

On cultures of sandy soil, Woburn. E. Dale Tom. cit.

M. sphaerosporus Hagem, in Schrift. Vidensk. Selsk. No. 7, p. 22 (1908).

On cultures of sandy soil, Woburn. E. Dale Tom. cit.

Rhizopus arrhizus Fisch. in Rabenh. Krypt. Flora p. 233 (1892).

On cultures of sandy soil, E. Dale Tom. cit.

Absidia Orchidis Hagem Schrift Vidensk. Selsk. No. 7, p. 40 (1908).

On cultures of sandy soil, E. Dale Tom. cit.

DISCOMYCETES.

Eremascus fertilis Stoppel in Flora XCVII. p. 332 (1907).

In bee-hives, appearing to grow on the pollen.
A. Betts in Journ. Econ. Biol. VII., p. 136 (1912).

Taphrina rhizophora Johans. in Bih. K. Svensk. Vet.-Akad. Handl. XIII. III., N. 4, p. 18 (1887).

Asci on the exterior of the pistils, the apices rather rounded, the base somewhat attenuate and immersed between the cells of the epidermis or hypodermis, without a basal cell, 80-156μ long, the free part 16-22μ thick; spores globose, 4μ diam., the asci almost filled with minute sporidioles.

On the pistils of *Populus alba*, turning them a bright orange colour. Coll. E. Armitage, Dadnor, Ross, Herefordshire. Comm. F. J. Chittenden, April, 1912. See also O. V. Darbishire in Journ. Bot. L., p. 230 (1912).

Urceolella incarnatina Boud. Icon. Mycol. IV., p. 312 (1911).

Ascocarps very small, pale-rose coloured, 200-300μ in diam., very finely pubescent, scarcely cupuliform, covered with short white hairs tapering upwards, non-septate and longer towards the margin which is thus finely ciliate; paraphyses scanty, septate, colourless, not thickened upwards, simple or divided; asci small, 40-45$\mu \times$ 7-9μ; spores oblong-fusiform, sometimes slightly bent, colourless, 9-11$\mu \times$ 3-3·5μ, when mature slightly clavate, septate and slightly larger, 10-15$\mu \times$ 3-4μ.

On decaying stalks of *Cirsium oleraceum*. C. Rea and H. C. Hawley, in Proc. Roy. Irish Acad. XXXI. pt. 13, p. 25 (1912). (Clare Island Survey).

U. aspera Boud. Tom. cit. p. 313.

Ascophores minute, up to $\frac{1}{2}$ mm. in diam., rather hard, brownish, urceolate, opening when moist, covered with stiff waving hairs which are non-septate, obtuse, whitish, sometimes anastomosing and connivent; paraphyses septate, not thickened upwards, colourless; asci cylindrical-oblong, 60-70$\mu \times$ 10-11μ; spores clavate, colourless, simple, 10-15$\mu \times$ 3-3·5μ.

On stems of *Osmunda regalis*, giving them a somewhat granulate surface. C. Rea and H. C. Hawley in Tom. cit. p. 13.

Lachnea coprinaria Phill. *var. minima* Grove. in Journ. Bot. L., p. 46 (1912).

On rabbit's dung, Sutton Park, May.

Orbilia Boydii n. sp.

Ascomata erumpentia, sparsa, patellato-applanata, fusco-succinea, circa ·5 mm. lata; Ascis clavatis breviter stipitatis, $70\text{-}80\mu \times 10\text{-}13\mu$, iodo non caerulescentibus; paraphysibus filiformibus, sursum clavulatis, usque ad 7μ latis, ramulosis: sporidiis oblongis $15\text{-}23\mu \times 3\text{-}5\mu$, rectis vel leniter curvatis.
In caulibus *Vaccinii Myrtilli.*
Coll. D. A. Boyd, at Beith, Ayrshire, July 1912.

Sclerotinia muscorum n. sp.

Sclerotiis oblongis teretibus, inter musci cujusdam folia absconditis, extus nigris intus roseo-albis circa 2·5 mm. longis ·5 mm. crassis; ascomatibus solitariis longe stipitatis tenerrimis; stipite filiformi terete flexuoso 5 mm. longo ·25 mm. crasso rufo-succineo, e cellulis elongatis $50\text{-}55\mu \times 5\text{-}10\mu$ composito; ascomate proprio minimo primum coniformi clauso, verruculoso roseolo, dein expanso denique palelliformi circa 1 mm. lato, margine incurvato; ascis cylindraceis breviter stipitatis $100\mu \times 10\mu$ octosporis; sporidiis irregulariter monostichis simplicibus hyalinis $10\text{-}15\mu \times 3\text{-}4\mu$; paraphysibus filiformibus vel leniter clavatis 3μ latis.
Ad folia *Campylopi atrovirentis.*
The ascophore before expanding resembled a minute raspberry both in colour and form.
We have to thank Dr. H. C. I. Gwynne-Vaughan for the specimen which was collected at Slieve Donnard, near Belfast, April 1912, and Mr. Gepp who determined the moss.

HYSTERIACEAE.

Gloniopsis Mülleri Sacc. Syll. II., p. 774 (1883).

Ascocarps erumpent, becoming entirely superficial, scattered or gregarious, black, shining, ovate or linear, short, rigid, the margins tumid leaving a narrow disc.; asci large, cylindrical; spores large, ovate-ellipsoid, colourless or yellowish, 3-6 septate and then muriform.
On corticate or decorticate branches of Myrtle. C. Rea and H. C. Hawley, Tom. cit. p. 26.
Spore sizes are not given either in the original descriptions

nor here. In the Clare Island specimen they are described as 5-septate and rather smaller than in the specimens at Kew from the Levant.

PYRENOMYCETES.

THIELAVIA Zopf. in S. B. Bot. Ver. Prov. Brandenb. p. 105 (1876); Mass. in Roy. Bot. Gardn. Kew Bull. 1912, pp. 44-52 (1 pl.).

Perithecia globose, closed, without special attachments; asci short and broad, disappearing; paraphyses wanting; spores 8 in the ascus, brown, simple. Conidia of two kinds; formed endogenously in cylindrical branches, and in chains on the same mycelium.

Th. basicola Zopp. l.c. (*Torula basicola* B. & Br. Ann. Mag. Nat. Hist. ser. 2 V. p. 461 (1850); *Helminthosporium fragile* Sor. in Hedw. XV. p. 113 (1876); *Milowia nivea* Mass. in Journ. Roy. Micros. Soc. IV., p. 841 (1884); *Clasterosporium fragile* Sacc. Syll. Fung. IV., p. 386 (1886).

A very variable fungus. Lately very prevalent in this country, where it causes a disease of Sweet Peas, Asters and other plants.

Chaetomium chlorinum Grove. Journ. Bot. L., p. 46 (1912).

On rotting stems of Jerusalem Artichoke and similar stems, Sutton Coldfield and Hunnington. June, September.

C. chlorinum Grove var. *rufipilum* Grove l.c.

On stems of *Heracleum*, Hunnington.

Sordaria lignicola Fuck. Symb. Mycol. App. 1, p. 38 (326) (1871).

On soft wood, California, Harborne. August.
W. B. Grove Tom. cit.

Sordaria bombardioides Auersw. in Niessl. Beitr. p. 37 (1872); Massee and Salmon, Ann. Bot. XVI. (1902), 37, t. VI., f. 4.

On cow-dung, Grisedale Moor, near Abbeystead, Lancashire, April, 1911. H. J. Wheldon (Journ. Bot. LI., p. 184 (1912)).

Wallrothiella minima Sacc. Syll. I., p. 455 (1882).

Seated among the fibres of bare wood, King's Norton and Selly Oak, December-August.
W. B. Grove Tom. cit.

CHAETOMASTIA Berl. Icon. Fung. I., p. 38 (1890-94). *Melanomma* subgenus *Chaetomastia.*

Perithecia superficial or immersed, setose; asci 8-spored; spores pluriseptate, coloured.

Differs from *Melanomma* in the pilose perithecia.

C. canescens (Speg.) Berl. Tom. cit. p. 39.

Perithecia globose or subspherical, minute $\frac{1}{4}$ to $\frac{1}{3}$ mm. diam., black, subcarbonaceous, with a papillate ostiole beset with somewhat dark-coloured continuous or 1-2-septate hairs, 100-200μ long, 5-7μ thick, asci cylindrical-clavate, 8-spored 70-90$\mu \times$ 15-18μ; spores bi-seriate or obliquely monoseriate, 3-septate, scarcely constricted, ellipsoid or ovoid-ellipsoid, 20-25$\mu \times$ 10μ, at first colourless then pale greenish brown.

On decaying fir posts. H. J. Wheldon in Journ. Bot. LI., p. 186 (1912). (Coll. near Wennington, Lancashire).

Trichosphaeria crassipila Grove Tom. cit.

On decayed wood, Studley Castle, November.

Rosellinia anthostomoides Berl. in Bull. Soc. Mycol. Fr. V., p. 39 (1889).

Perithecia scattered, globose-conical, with a thickish prominent ostiole, 400-500μ diam., carbonaceous; asci cylindrical, with a short nodulose base, 140-150$\mu \times$ 18-20μ; paraphyses filiform, discrete, longer than the asci, guttulate; spores broadly ellipsoid or almost globose, 18-20$\mu \times$ 14-16μ, at first with a large guttula, bright-brown then pale-smoky-brown.

On dead bark. C. Rea and H. C. Hawley in Proc. Roy. Irish Acad. XXXI. pt. 13, p. 5 (1912). (Clare Island Survey.)

R. mastoidea Sacc. Michelia II., p. 54 (1880).

On fallen branches, Studley Castle, April.
W. B. Grove Tom. cit.

Epicymatia Balani Wint. ex Hariot in Journ. de Bot. I., p. 233 (1887).

On *Brachytrichia Balani.* C. Rea and H. C. Hawley Tom. cit. . See Trans. Brit. Mycol. III., p. 98 (1908).

Leptosphaeria rubicunda Rehm. ex Wint. Rabenh. Krypt. Fl. I. 2, p. 467 (1885).

On stems of *Conium maculatum,* Studley Castle, November.
W. B. Grove Tom. cit. p. 49.

L. microscopica Karst. in öfv. K. Vet. Akad. Förh., 1872, No. 2, p. 104.

On culms and sheaths of *Dactylis glomerata* and *Phleum pratense*, Warwickshire, July-December.
W. B. Grove l.c.

Metasphaeria culmifida Sacc. Syll. II., p. 174 (1883).

On culms of *Poa*, Harborne, July.
W. B. Grove l.c.

Pleospora Thujae Grove l.c.

On external cone scales of *Thuja occidentalis*, associated with *Pestalozzia conigena*, Studley Castle, March.

Phomatospora Argentina Speg. Anal. Soc. Cient. Arg. Buenos Aires, IX., p. 178 (1880).

Perithecia gregarious, minute, 120-150μ diam., lenticular, globose, immersed, black, the ostiole acute, bursting the epidermis; asci cylindrical, rounded above, tapering to a pedicel below, 100-105 $\times$ 5μ, 8-spored; paraphyses not present; spores straight, uniseriate, ellipsoid-elongate, obtuse at the ends, 12-13μ $\times$ 3-4μ, colourless.

On dead stems of *Jussieua longifolia.* C. Rea and H. C. Hawley in Proc. Roy. Irish Acad. XXXI. pt. 13, p. 11 (1912). On dead stems of *Beta maritima* on the Bills (Clare Island Survey).

Gnomonia lugubris Karst. Myc. Fenn. II., p. 121 (1873).

Perithecia scattered, innate, spherical, depressed when dry, black, about 200-225μ wide, with a cylindrical obtuse beaked ostiole; asci sessile, fusiform-oblong, 65-70μ $\times$ 12-15μ, 8-spored; spores bi-seriate, fusiform-oblong, unequal sided, with 4 large guttulae, colourless, 18-20μ $\times$ 6μ.

On leaves of *Potentilla palustris.* Coll. D. A. Boyd at Neilston, Renfrewshire, August, 1912.

The spores in Mr. Boyd's specimen are 1-septate but the species is evidently the same as that described by Karsten, which may have been immature at the time of collecting.

Diaporthe exasperans Nitschke Pyr. Germ. p. 289 (1867).

Stromata effuse, short and spot-like, or sometimes surrounding the smaller branches, limited by a black line; perithecia equally dispersed or in crowded groups, immersed, very small, globose becoming strongly depressed; ostioles short, cylindrical or conical, bursting the periderm singly or in groups and not prominent, or rarely elongate, cylindrical, bent and pro-

minent; asci clavate, or oblong, sessile, 8-spored, $56\text{-}68\mu \times 8\text{-}10\mu$; spores almost bi-seriate, fusiform or almost cylindrical, blunt at the ends, straight or slightly bent, septate, constricted, with 4 guttulae, colourless, $14\text{-}16\mu \times 4\text{-}5\mu$.

On dead branches of *Betula alba*. C. Rea and H. C. Hawley Tom. cit. p. 26.

D. Tulasnei Nitschke Pyren. Germ. p. 274 (1870).

On stems of *Urtica dioica*, Studley Castle, May. W. B. Grove, in Journ. Bot. L. p. 48 (1912).

Anthostoma saprophilum E. & E. in Journ. Mycol. III. p. 43 (1887).

Stromata effuse, limited internally by a black line, blackening the surface of the wood, indefinite from $\frac{1}{2}$ to 1 cm. or more in extent; perithecia immersed, irregularly arranged in groups of 6 to 10 or more, ostioles somewhat conical, prominent with a small round opening; spores ellipsoid, pale brown, 1-2 guttulate, uniseriate, $5\text{-}6\mu \times 2{\cdot}5\text{-}3\mu$.

On rotten Maple wood. C. Rea and H. C. Hawley Tom. cit. p. 26. Collected at Louisburgh, Mayo.

Diatrypella exigua Wint. in Hedw. XIII., p. 133 (1874).

Stromata minute, subcircular or elliptical in form, circumscissed at the base, pallid within; perithecia subglobose, 300μ in diam., 2-10 in each stroma; with short necks, the ostioles papillate, not prominent, 4-6-sulcate; asci cylindrical-clavate, long stalked, in all $110\text{-}150\mu \times 12\mu$, myriospored; spores minute, curved (allantoid), $8\mu \times 1{\cdot}5\mu$, brownish.

On branches of *Salix*. C. Rea and H. C. Hawley Tom. cit. p. 5.

Nummularia discreta Tul. Sel. Fung. Carp. II. p. 45 (1863).

Stromata erumpent, determinate, orbicular, disciform, the margin thick, greyish-brown, becoming black; perithecia numerous, immersed, with rather long, slender, cylindrical necks and small, non-projecting ostioles; asci cylindrical, stalked, 8-spored, $150\mu \times 13\mu$, paraphyses filiform, simple; spores uniseriate, almost globose, one-celled, blackish, $13\mu \times 10\mu$.

On the cortex of *Pirus Malus*, more rarely on *Betula*, *Sorbus*, &c. C. Crossland in Naturalist 1912, p. 88.

SPHAEROPSIDEAE.

Phoma acicola Sacc. Mich. II. p. 272 (1881).

On leaves of Scots pine, Marston Green, December, W. B. Grove in Journ. Bot. L., p. 50 (1912).

P. deusta Fckl. Symb. Mycol. p. 377 (1869).

On dry bracts, capsules and peduncles of *Rhinanthus Crista-galli*, Henley-in-Arden, February.
W. B. Grove Tom. cit. p. 51.

P. Grossulariae Schulz. et Sacc. ex Sacc. Syll. III. p. 88 (1884).

On twigs of Gooseberry, Studley Castle, November.
W. B. Grove Tom. cit. p. 50.

P. pinicola Sacc. Syll. III. p. 100 (1884).

On leaves of *Pinus Laricio*, still attached to broken branch, Studley Castle, October.
W. B. Grove l.c.

P. prunicola Schw. ex Sacc. Syll. III., p. 107 (1884).

On fallen dry leaves of *Prunus Lauro-cerasus*, Over Whitacre, April.
W. B. Grove l.c.

Phyllosticta Acetosellae n. sp.

Maculis subcircularibus, arescendo dilute ochraceis, zona purpurascenti-fusca cinctis, circa 7 mm. latis; peritheciis epiphyllis, sparsis, 130μ diam., poro rotundo pertusis; sporulis hyalinis, continuis, elliptico-cylindraceis, rectis vel curvulis, 2-guttulatis, 8-10$\mu \times$ 3-4μ.
In foliis languidis *Rumicis Acetosellae*.
Coll. D. A. Boyd, at Glengonner, Lanarkshire, June, 1912.

P. Aegopodii Allesch. in Hedw. XXXIV. p. 256 (1895).

Leaf spots not at first distinct, but gradually becoming brown and spreading. Pycnidia mostly on the under surface, scattered or several congregate, lentiform, immersed then free, 80-90μ in diameter, with an indistinctly plectenchymatous wall; spores numerous, rod-shaped, straight, blunt at the ends, 5-7μ long, 0·5-1μ thick, colourless.

On living leaves of *Aegopodium Podagraria*, often associated with *Septoria Podagrariae*.

In the specimen coll. D. A. Boyd at Loch Winnoch, Renfrew, in July, 1912, the pycnidia are distinctly smaller, about 65-75μ in diameter and the spores slightly different, being somewhat ellipsoid and usually measuring 3-5μ by 1-2μ. These differences do not however seem to be of specific value.

P. carpathica Allesch. & Syd. in Hedw. Beibl. XXXVI. p. 157, 1897.

Spots small, somewhat irregular, visible on both sides of the

leaf, whitish with a dark-brown margin. Pycnidia on both sides of the leaf, small, scattered, black; spores cylindrical, simple (rarely setate), 8-12μ long, 2-2·5μ thick.

On living leaves of *Campanula*. Coll. D. A. Boyd on *C. persicifolia* at Saltcoats, Ayrshire, August, 1911.

P. Eupatorii Allesch. in Ber. Bayer. Bot. Ges, p. 3 (1896).

Spots small almost circular, dark ash-grey with an indistinct purple margin, often confluent and covering large areas of the leaf; pycnidia small, epiphyllous, scattered, globose, black; spores almost cylindrical, simple, with two guttulae, 10-15μ × 3-5μ, colourless.

On leaves of *Eupatorium cannabinum*. Coll. D. A. Boyd at West Kilbride, Ayrshire, August, 1911.

P. eximia Bubak, Pilzfl. Montenegr. 1903, p. 11.

Spots on both sides of the leaves angular limited by the veins, dark-brown or blackish; pycnidia amphigenous, numerous, crowded, hemispherical, minute, 60-120μ in diameter, dark-brown or blackish, shining; spores oblong 4-6·5μ × ·5-1μ.

On leaves of *Crepis*. (On spots previously attacked by *Ramularia eximia*.

Coll. D. A. Boyd on fading leaves of *Crepis paludosa* at Neilston, Renfrewshire, July, 1912.

The general appearance of the leaf spots and the size of pycnidia and spores agree with the description of Bubak's species. The pycnidia are rather light in colour but that may be because they are somewhat immature.

P. hederaecola Dur. et Mont., Mont. Syll. Crypt. p. 279 (1856).

On Ivy leaves, Warwick.
W. B. Grove in Journ. Bot. L. p. 50 (1912).

P. japonica Thüm. ex Sacc. Syll. III. p. 25 (1884).

On fading leaves of *Mahonia japonica*, Studley Castle, May.
W. B. Grove l.c.

P. Umbilici Brunaud in Act. Soc. Linn. Bord. XLIV. p. 242 (1891).

Spots indeterminate, pale. Perithecia loosely gregarious, numerous, small, globose-lenticular, brown, the wall formed of

small-celled plectenchyma, about 150-180μ in diameter; spores ellipsoid, 2-guttulate, colourless, 5-6μ × 2·5μ.

On leaves and stalks of *Cotyledon Umbilicus*. Coll. D. A. Boyd at Largs, Ayrshire, July, 1910.

Pyrenochaeta Ilicis Wils. in Scott. Bot. Rev. I. p. 161 (1912).

Found by Wm. Nowell on dead Holly leaves on Wimbledon Common, near London, Summer, 1911.

Ascochyta aricola n. sp.

Maculis latis, viridibus, dein brunneis, amphigenis et conspicuis, haud marginatis; peritheciis epiphyllis vel rare amphigenis, dense gregariis, subgloboso-lenticularibus, prominulis, 180μ-200μ diam., poro rotundo pertusis; contextu plectenchymatico pallide brunneo; sporulis oblongo-ellipsoideis, rectis, interdum leviter curvatis, 1-septatis, hyalinis, 8-10μ × 2-3μ.

Hab. in foliis languescentibus *Ari maculati*.

Coll. D. A. Boyd, West Kilbride, Ayrshire, June, 1912.

A. Brassicae Thüm. Contr. Myc. Lusit. N. 602; Sacc. Syll. III. p. 397 (1884).

Leaf spots dull yellowish-grey, sinuate, not marginate. Pycnidia densely gregarious on the upper surface of the leaves, conical, prominent, moderate in size; spores fusiform, straight, both ends acute, 1-septate, 15-16μ long, 3-4μ thick, with two or four large guttulae, colourless.

On leaves of *Brassica oleracea*. Coll. J. Adams at Antrim, N. Ireland, determined by W. B. Grove in Irish Naturalist XXI., p. 112, 1912.

A. Deutziae n. sp.

Maculis vagis, arescendo candicantibus, non marginatis; peritheciis numerosis, sparsis, punctiformibus, atris, 175-200μ diam.; sporulis 7-10μ × 2-3μ, 1-septatis, hyalinis. Hab. in foliis dejectis *Deutziae gracilis*.

Coll. D. A. Boyd, Saltcoats, Ayrshire, November, 1910.

A. Doronici Allesch. ex Syd. in Hedw. Beibl. XXXVI., p. 162 (1897).

Spots large, ovate, visible on both sides of the leaf, dark-ash-grey or almost yellowish with a dark margin. Pycnidia innate somewhat prominent, dark-brown; spores elongate, somewhat cylindrical, straight, rarely bent, 1-septate, slightly constricted, colourless, 8-12μ × 2·5-3·5μ thick.

On fading leaves of *Doronicum*. Coll. D. A. Boyd at Perceton, Ayrshire, June, 1912.

A. Valerianae n. sp.

Maculis utrinque conspicuis, angulatis, brunneis, fusco-marginatis, circa 5-10 mm. diam., vel confluentibus majoribusque; pycnidiis epiphyllis, globoso-depressis, innatis, 120-180μ diam., poro rotundo minuto pertusis, contextu parenchymatico pallide brunneo; sporis elliptico-oblongis, medio 1-septatis, leniter constrictis, 8-10 × 2-3μ, hyalinis.

Hab. in foliis vivis *Valerianae pyrenaicae*.

Coll. D. A. Boyd, at Beith, Ayrshire, July, 1912.

Diplodina graminea Sacc. in Mich. II., p. 279 (1881).

On culms of *Dactylis*, Selly Oak, December.

W. B. Grove l.c. in Journ. Bot. L. p. 51 (1912).

Darluca genistalis Sacc. Mich. II., 1880, p. 108.

Perithecia minute, forming dense, erumpent, tuberculose, black, subhemispherical groups: spores as in *D. Filum*.

On sori of *Uromyces Anthyllidis*, Co. Dublin.

W. B. Grove in Irish Naturalist XXI., p. 112, 1912.

Septoria Acetosae Oudem. Contr. Flor. Mycol. des Pays-Bas XV., p. 16 in Nederl. Kruikkund, Arch. ser. 2, VI., pp. 279-98 (1894).

Spots rust-coloured, often with a purple margin, up to 1 cm. broad. Perithecia numerous, emerging on both sides of the leaf, usually small; spores cylindrical 1-3-septate, 40-50μ long, 4-5μ thick.

On leaves of *Rumex Acetosa*. Coll. D. A. Boyd, at Rothesay, Bute, July, 1912.

S. Asperulae Bäumler Fungi. Schemn., p. 4; Sacc. Syll. X. p. 373 (1892).

Spots at first irregular then covering the whole leaf, becoming grey with a dark-brown margin. Pycnidia congregate, globose, small, 60-80μ in diam. with reddish-yellow walls and a minute pore; spores elongate-filiform, somewhat bent, tapering towards the ends, with several guttulae, 40-50μ × 2μ, colourless.

On *Asperula odorata*. Coll. D. A. Boyd, at West Kilbride, Ayrshire, September, 1911.

S. Bromi Sacc. Var. *Brachypodii* Sacc. Syll. III., p. 562 (1884).

Spots indistinct, white, long. Pycnidia numerous, globose-lentiform, with a pore at the apex; spores filiform-clavate,

pointed at one end, blunt at the other, or simply filiform, 25-30$\mu \times$ 1-1·2μ, bent, colourless.

On leaves of *Agrostis alba*. Coll. D. A. Boyd, at Stevenston, Ayrshire, August, 1911.

S. chrysanthemella Sacc. Syll. XI., p. 542 (1895).

Spots circular, varying in dimensions, brownish-red, ochre-coloured in the centre. Perithecia minute, the walls thin of yellowish cells, and with a conical ostiole; spores colourless, narrow, filiform, pointed at each end, simple, with minute oil-drops, 55-65μ long, 1·5-2μ thick.

On leaves of cultivated *Chrysanthemum*. Recorded previously from N. Italy. Coll. D. A. Boyd on *C. leucanthemum*, at Glengonnar, Lanarkshire, June, 1912.

S. Crepidis Vestergr. in Bihang. K. S. Vet. Akad. Handl. XXII. p. 24 (1896).

Spots amphigenous, rather large, almost round, irregularly confluent, indistinctly margined, dark brown, becoming whitish in the middle. Pycnidia numerous, slightly projecting on either side of the leaf, with a papillate ostiole gradually opening to a wide pore; spores thread-like, straight or somewhat bent, pointed at the ends, 25-35$\mu \times$ 1μ, usually with several guttulae or septa, colourless.

On leaves of *Crepis*. Coll. D. A. Boyd, on leaves of *C. paludosa*, at Beith, Ayrshire.

S. Paeoniae Westend. Var. *berolinensis* Allesch. ex Syd. in Hedw. Beibl. XXXV., p. 31 (1896).

Spots almost round, yellowish with concentric folds, becoming whitish in the centre with a purple margin, 2-8 mm. in diam. Pycnidia on the under surface, congregate, immersed, brown with a pore-like ostiole; spores elongate-fusiform, somewhat bent, pointed at the ends, with several indistinct guttulae, 25-30$\mu \times$ 1·5-2μ, colourless.

On leaves of *Paeonia*. Coll. D. A. Boyd, at Largs, Ayrshire, July, 1911.

S. quevillensis Sacc. Syll. III., p. 512 (1884).

Spots on the upper surface of the leaf, small, blackish-red, becoming white in the centre. Pycnidia lentiform, the walls yellowish, 60-80μ in diam., widely open, causing punctate holes in the leaf; spores rod-like, somewhat bent, with several guttulae, 30-40μ long, 1-1·5μ thick, colourless.

On leaves of *Spiraea Ulmaria*. Coll. D. A. Boyd, at West Kilbride, Ayrshire, August, 1912.

Stagonospora graminella Sacc. Syll. III., p. 454 (1884).

On leaves of grasses, Handsworth, Staffs., September. W. B. Grove in Journ. Bot. L. p. 52 (1912).

S. socia Grove l.c.

In dried culms of *Juncus conglomeratus* together with *Phyllachora junci*, Frankley, September.

S. Trifolii Fautrey in Rev. Mycol. 1890, p. 167.

Pycnidia immersed, opening by a pore, growing on spots. Spores cylindrical, 3-septate and guttulate, colourless, 16-22$\mu \times$ 3-4μ.

On living leaves of *Trifolium repens.* Coll. D. A. Boyd, at West Kilbride, Ayrshire, Summer 1911.

The spores remain for a considerable time 1-septate, but finally become 3-septate. The species has been previously recorded from Noidan in the Côte d'Or, France.

MELANCONIEAE.

Gloeosporium curvatum Oudem. Mat. Fl. Neerl. II., p. 28 (1867).

Spots on the under side of the leaf, dark brownish. Spore groups somewhat prominent, small; spores at first involved in mucous then ejected in the form of short, thick, white, cirri, elongate, strongly bent or curved, blunt at the ends, 14-20$\mu \times$ 5-7μ, with two guttulae, colourless.

On leaves of *Ribes nigrum.* Coll. D. A. Boyd, at West Kilbride, Ayrshire, July, 1912.

G. phacidiellum Grove Tom cit., p. 53.

On living leaves of *Prunus laurocerasus*, Studley Castle, March.

"Probably the pycnidium stage of *Trochila laurocerasi.*"

G. Phillyreae Grove, l.c.

On dead leaves of *Phillyrea media*, Studley Castle, April.

G. pruinosum Bäumler in Oesterr. Bot. Zeitschr. XXXIX., p. 172 (1889).

Spots ash-grey-pruinose, with a dark-brown margin. Pustules on the under side of the leaf up to 1 mm. in diam.; spores emerging in masses and giving the spots the pruinose character, straight or almost straight, rounded at the ends, 14-18$\mu \times$ 3-4μ, with guttulae or clouded, colourless; the sporophores 10$\mu \times$ 2μ.

On fading leaves of *Veronica.* Coll. D. A. Boyd on *V. Beccabunga*, at Beith, Ayrshire, May, 1912.

CRYPTOSTICTELLA Grove. Journ. Bot. L., p. 52 (1912) gen. nov.

Pycnidia erumpent, globose. Spores 2-pluriseptate, 1-aristate at each end, hyaline.

C. bractearum Grove l.c.

On bracts of *Tillia europaea*, Studley Castle, December.

Diplodia Buxi Fr. Summa Veg. Sc., p. 417 (1849).

On half-dead Box-leaves, Sutton Coldfield, January.
W. B. Grove l.c.

Discula macrosperma Sacc. var. *fraxini* Grove l.c.

On branches of *Fraxinus excelsior*, Over Whitacre, April.

Marssonia Aegopodii n. sp.

Maculis suborbicularibus, solitariis, subinde confluentibus, pallide fuscis; acervulis epiphyllis, convexis, fulvescentibus; sporulis oblongo-ellipsoideis, infra medium 1-septatis, leniter constrictis, rectis, hyalinis, $15\text{-}22\mu \times 6\text{-}7\mu$.

In foliis languescentibus *Aegopodii Podagrariae*.

Coll. D. A. Boyd, at Largs, Ayrshire, July, 1911, and at Rothesay, Bute, July, 1912.

M. Betulae Sacc. Syll. X., p. 477 (1892).

Leaf spots irregular in form, almost stellate. Pustules on the under side of the leaf, congregate, rather flat, longish or without definite form, sometimes confluent, dark-brown, wrinkled, at last circumscissed at the base; spores elongate, unequal-sided, rounded or somewhat angular at the lower end, 1-septate, becoming constricted, $17\text{-}22\mu \times 8\text{-}10\mu$, colourless.

On leaves of *Betula alba*. Coll. D. A. Boyd at West Kilbride, Ayrshire, August, 1912.

M. Lappae n. sp.

Maculis epiphyllis, solitariis vel confluentibus, subcircularibus, fusco-cinerescentibus; acervulis exiguis, sparsis, fulvescentibus; sporulis suboblongis, rectis vel leniter curvulis, infra medium, 1-septatis, $8\text{-}10\mu \times 2\mu$.

Hab. in pagina superiore foliorum *Arctii Lappae*.

Coll. D. A. Boyd, at Carradale, Cantyre, Argyll, July, 1911.

M. Castagnei Sacc. Syll. III., p. 768 (1884).

On fading leaves of *Populus nigra*, Olton, November.
W. B. Grove Tom. cit., p. 53.

M. Panattoniana Berl. in Rev. Patol. Veget. III., p. 342 (1895).

Leaf spots roundish, often confluent, pale with a darker margin, often dropping out, 3 to 5 mm. in diameter; pustules gregarious, at first subcutaneous, later liberated by the breaking down of the epidermis; conidia obclavate, $11\text{-}20\mu \times 3\text{-}4\mu$, 1-septate across the middle, hyaline, granular; basidia short.

On living leaves of lettuce, near Haslemere, Surrey. F. J. Chittenden in Journ. Roy. Hort. Soc. XXXVII. (1912) p. 541.

Septomyxa Sacc. Syll. III., p. 766 (1884).

Pustules depressed-globose, erumpent, somewhat fleshy, often brightly coloured; spores ellipsoid or elongate, 1-septate, colourless.

S. Negundinis Allesch. in Ber. Bay. Bot. Ges. V., p. 22 (1897).

Pustules erumpent, surrounded by the torn epidermis, dark-brownish-red; spores elongate or almost fusiform, blunt at the ends, mostly straight, sometimes slightly bent, 1-septate or with guttulae, colourless, $12\text{-}20\mu \times 2{\cdot}5\text{-}4\mu$. Sporophores almost cylindrical, slightly longer than the spores.

On dead branches of *Acer*. Coll. D. A. Boyd, on recently dead branches of *Acer Pseudo-platanus*, at West Kilbride, Ayrshire, April, 1912.

Coryneum Kunzei Corda var. *Castaneae* Sacc. et Roum. Reliq. Myc. Libert. IV. No. 180. Rev. Mycol. 1884, p. 36.

Spores with long stalks, spindle-shaped, attenuate below, $50\text{-}52\mu \times 10\text{-}12\mu$, 5-septate, dark brown, with blunt almost colourless apex.

On dead branch of Castanea.

The specimen collected by Mr. D. A. Boyd at West Kilbride, Ayrshire, April, 1912, on *Castanea sativa* agrees with the above description but shows a greater variation in the size of the spores ($50\text{-}64\mu \times 10\text{-}15\mu$) and in the number of septa (up to 7).

Pestalozzia conigena Lév. in Ann. Sci. Nat. V., p. 285 (1846).

On cones of *Thuja occidentalis*, Studley Castle, March. W. B. Grove Tom. cit. p. 54.

Libertella Ulmi-suberosae Oudem. in Hedwigia XXXVII., p. 180 (1898).

Pustules scattered or congregate, immersed in the outer bark, depressed-globose, surrounded by a dark cellular tissue somewhat like a perithecium; sporophores numerous, almost straight; spores curved, or bent, $25\text{-}50\mu \times 1{\cdot}2\mu$.

On branches of *Ulmus*. Coll. D. A. Boyd at West Kilbride, Ayrshire, August, 1912.

HYPHOMYCETES.

Monilia sitophila Sacc. in Mich. II., p. 359 (1881).
On steamed Oatmeal.
C. Crossland in Naturalist No. 662, p. 88 (1912).

Trichoderma Koningi Oud. in Arch. Néerland Sci. ex. et nat. 2. ser. VII., p. 291 (1902).

On cultures of sandy soil, E. Dale in Ann. Mycol. X., p. 461 (1912).

T. album Preuss in Linnaea XXIV., p. 141 (1851).
On cultures of sandy soil. E. Dale l.c.

Aspergillus nidulans Wint. Rab. Krypt. Fl. II., p. 62 (1887).
In beehives, in dead stocks.
A. Betts in Journ. Econ. Biol. VII., p. 145 (1912).

Citromyces glaber Wehmer in Beitr. Kenntn. Pilze I., p. 24 (1893).
In bee-hives.
A. Betts Tom. cit. p. 147.

C. subtilis Bain. et Sart. in Bull. Soc. Mycol. France XXVIII., p. 46 (1912).
In bee-hives.
A. Betts Tom. cit. p. 148.

Ovularia decipiens Sacc. in Mich. II., p. 546 (1882).

Spots subcircular, yellowish, then becoming dried and blackish. Tufts white, hypophyllous, loose. Fertile hyphae in tufts, thread-like, strongly bent, non-septate. Conidia obovate, hyaline, 19-25$\mu \times$ 10-12μ.

On *Ranunculus acris*. Coll. D. A. Boyd, at West Kilbride, Ayrshire, June, 1912. See also Scott, Nat. 1890, p. 281.

O. sphaeroidea Sacc. Syll. IV., 140 (1886).

Leaf spots mostly angular, 2-5 mm. in diameter, hypophyllous, flat, white, later brownish. Fertile hyphae projecting in bundles from the stomata, hyaline, 40-50μ long by 3μ broad, bent and knotted in places, and provided with toothed projections towards the top. Conidia borne at the ends and sides, spherical, 8-10μ in diameter, seldom somewhat smaller and elliptical, 8$\mu \times$ 7μ, hyaline with a small projection at the base.

On *Lotus uliginosus*. Coll. and determined by D. A. Boyd, West Kildride, Ayrshire, July, 1912. See also Scott. Nat. 1891, p. 32.

Ramularia lychnicola Cooke in Grev. XIV., p. 40 (1885).

On leaves of *Lychnis diurna.*

Referred by Mr. Massee to *Ovularia* (Brit. Fung. Flora Vol. III., p. 320).

Specimens collected by D. A. Boyd at West Kilbride, Dalry and Lochwinnoch, have been examined, in which the spores are distinctly septate, measure $12\text{-}23\mu \times 4\text{-}5\mu$, and agree with Cooke's original description.

Candelospora Hawl. in Proc. Irish Acad. XXXI. N. 13, p. 11 (1912).

Sterile hyhae creeping. Conidiophores erect, septate, hyaline, irregularly branched or sometimes simple, penicillately divided above. Conidia produced singly at the tips of the ultimate branches, multiseptate, hyaline.

Differs from *Mucrosporium* in the penicillate branching and in the conidia produced singly at the tips of the branchlets.

C. ilicicola Hawl. l.c.

Conidiophores gregarious, about 100μ long, 7μ thick; branches at the apices dividing into two or at most three minute branchlets. Conidia 3-septate, cylindrical, obtuse, $50\text{-}60\mu \times 6\text{-}7\mu$, forming a capitulum involved in mucus.

On dead leaves of *Ilex Aquifolium*, forming small, scattered, white tufts over the upper surface of the leaf. When free of the mucus, they stand up side by side like so many candles. Clare Island, Mayo.

Trichosporium chartaceum Sacc. in Rev. Mycol. VII., p. 224 (1885).

On damp paper, Birmingham, May.

W. B. Grove in Journ. Bot. L. p. 44 (1912).

Scolecotrichum graminis Fuck. Symb. Mycol. p. 107 (1869).

On under side of living leaves of *Phleum pratense*, Marston Green (Warwick), July.

W. B. Grove l.c.

Diplococcium spicatum Grove, in Journ. Bot. XXIII., p. 167 (1885).

Grove has again found this species and has corrected the measurements of conidia to $20\mu \times 10\mu$. W. B. Grove in Journ. Bot. L. p. 44 (1912).

Helminthosporium inconspicuum C. et E. in Grevillea Vol. VI., p. 88 (1878).

On fading grass leaves, Longdon Green, Lichfield, September.
W. B. Grove l.c.

Heterosporium gracile Sacc. Syll. IV., p. 480 (1886).
On leaves of *Iris germanica*, Studley Castle, October.
W. B. Grove Tom. cit. p. 45.

Speira cohaerens Preuss ex Sacc. Syll. IV., p. 515 (1886).
On bark, Maxstone Priory (Warwick), August.
W. B. Grove l.c.

Speira effusa Sacc. Syll. IV., p .514 (1886).
On dead wood, Studley Castle, March.
W. B. Grove l.c.

Septosporium elatius Grove l.c.
On bark, Aberystwyth, January.

Alternaria tenuis Nees. Syst. p. 72 (1816).
On various leaves and stems, Edgbaston, Studley, &c.
W. B. Grove l.c.

Macrosporium ignobile Karst. in Med. Soc. Faun. Flor. Fenn. XIV. 100 (1888).

Very thin forming greyish brown spots. Fertile hyphae decumbent, brown, unbranched, with many cross walls, dirty smoke-colour, rather short, 160-180μ long, 6-9μ thick. Conidia clavate or pear-shaped, tapering below, sessile or shortly stalked, with 2-7 cross-walls and with an incomplete longitudinal wall, 27-60$\mu \times$ 9-15μ.

On fading leaves of *Arum maculatum*. Coll. D. A. Boyd at West Kilbride, Ayrshire, June, 1912.

Stemphylium botryosum Wallr. Fl. Crypt. Germ. II., p. 300 (1833).
On cultures of sandy soil, Woburn. E. Dale Tom. cit. p. 470.

Alternaria humicola Oud. in Arch Néerland. sci. ex. et nat. 2 ser. VII., p. 292 (1902).
On cultures of sandy soil, Woburn. E. Dale l.c.

Nematogonum humicola Oud. in Arch Néerland. sci. ex. et nat. 2 ser. VII., p. 288 (1902).
On cultures of sandy soil, Woburn. E. Dale Tom. cit. p. 466.

Basisporium Molliard in Bull. Soc. Mycol. France XVIII., p. 169 (1902).

Sterile and fertile hyphae creeping, for a long time hyaline then dark brown. The ultimate branchlets pleurogenous or acrogenous bearing swollen, ampuliform basidia. Conidia solitary, subspherical, smooth.

B. gallarum Moll. l.c.

On cultures of sandy soil, Woburn. E. Dale l.c.

Graphium Passerinii Sacc. Syll. IV., p. 613 (1886).

On dried twigs of Bramble, Hunnington, June. W. B. Grove Tom. cit. p. 46.

Stysanus Mandlii Mont. in Ann. Sci. Nat. p. 365 (1845).

On twigs of Gooseberry, Studley Castle, April. W. B. Grove l.c.

Sphacelia Curreyana Grove in Journ. Bot. L. p. 46 (1912).

On sclerotia of *Sclerotinia Curreyana* in Juncus, Sutton Park. W. B. Grove l.c.

Hymenula callorioides Sacc. var. *corticis* Grove l.c.

On bark, Studley Castle, April.

Pericystis alvei Betts in Ann. Bot. XXVI., p. 795 (1912).

On pollen stored in the combs in bee-hives.

UREDINEAE.

Uromyces striatus Schroet. Schles. Ges. Vaterl. Cult. Breslaw 1872, p. 11.

On *Trifolium minus*. W. B. Grove in Journ. Bot. XLIX., p. 367 (1911).

U. Loti Blytt in Christiania Vid. Selsk. Forh. 1896, n. 6, p. 37.

On *Trifolium minus*. W. B. Grove l.c. Cf. Plowright Brit. Ured. & Ustil. p. 134 (1889).

U. flectens Lagerh. in Svensbr. Bot. Tids. III., p. 36 (1909).

On *Trofolium repens*. W. B. Grove Tom. cit. p. 366.

U. Lilii Fuck. Symb. Myc. Nachtr. III., p. 16 (1875).

On leaves of *Lilium candidum*. W. B. Grove Tom. cit. p. 368. Also F. J. Chittenden, April 1912.

Puccinia Zopfii Wint. in Hedw. 1880, pp. 39 & 107.

This species differs from the closely related *Puccinia Calthae* Link in having teluetospores with warted epispores, the margin of the pseudoperidium is slightly incised forming 4-5 broad laciniae.

On *Caltha palustris* collected by J. Adams at Antrim, N. Ireland, determined by W. B. Grove in Irish Naturalist XXI., p. 112, 1912.

In the herbarium at the British Museum there are specimens of this Puccinia from Yorkshire, North Wales, and Scotland.

USTILAGINEAE.

Doassansia Martianoffiana Schroet. Pilzfl. Schles. p. 287.

Sori situated just above the lower epidermis in the large air cavities of the leaf, subglobose, 100-160μ in diameter, numerous, densely gregarious, in nearly circular spots which are a very pale yellow colour, orbicular, and immarginate, reaching a diameter of 5 mm. Spores slightly elongated radially, $12\mu \times 6\text{-}8\mu$, epispore thin, smooth, pale brownish; investing cells of the sorus brownish with an outer covering of scanty hyphae.

Coll. D. A. Boyd on leaves of *Potamogeton sp.*, at Ardrossan, Ayrshire, August, 1911.

NEW AND RARE BRITISH FUNGI.

By Carleton Rea, B.C.L., M.A., &c.

WITH PLATES 5 and 6.

Lepiota medioflava Boud. Bull. Soc. Myc. Fr. X. (1894) 59, t. I. f. 1.

On decaying cocoanut fibre and soil in greenhouse, Hebden Bridge, James Needham, October, 1911. Naturalist (1912) March, 86.

Tricholoma humile var. *evectum* Grove. Journ. Bot. L. (1912) 9.

Pileus 7·5-9 cm. wide, plane then depressed and concave, glabrous, smooth, hygrophanous, fuscous becoming paler; margin entire, not striate; flesh pallid. Stem 7·5-8 cm. long, 8 mm. thick, slightly thickened at the apex and wider at the base, fibrous, stuffed, somewhat fuscous, punctato-squamulose, somewhat striate, whitish, pulverulent upwards. Gills crowded, sinuate, pale ochraceous, thin, edge entire. Spores very white, oval, $6\text{-}7 \times 4{\cdot}5\mu$.

On heaps of dead leaves, Studley Castle, Warwickshire, September-October.

Clitocybe incana Quél. sub *Omphalia orbiformis* Fr. var. *incana*. As. Fr. (1886) 485; Fl. Myc. 241; and see plate 5.

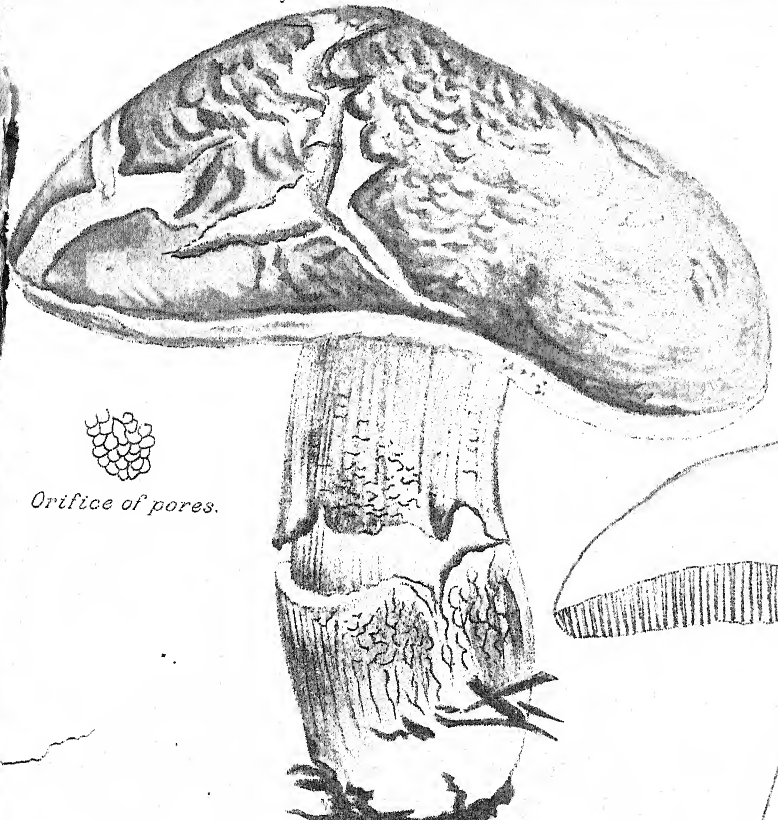
Pileus 3-5 cm. wide, convexo-plane then depressed, hygrophanous, pruinose, *mouse grey, margin white.* Stem 4-6 cm. long, 4-6 mm. thick, stuffed, straight or slightly curved, pearl grey, white floccose at the base. Flesh *soft,* greyish. Smell none. Gills 2-4 mm. wide, decurrent with a tooth, greyish becoming somewhat ochraceous. Spores white, globose, 3μ diam.

Amongst fir needles, Swarraton, Hants, 31st October, 1912, Rev. W. L. W. Eyre.

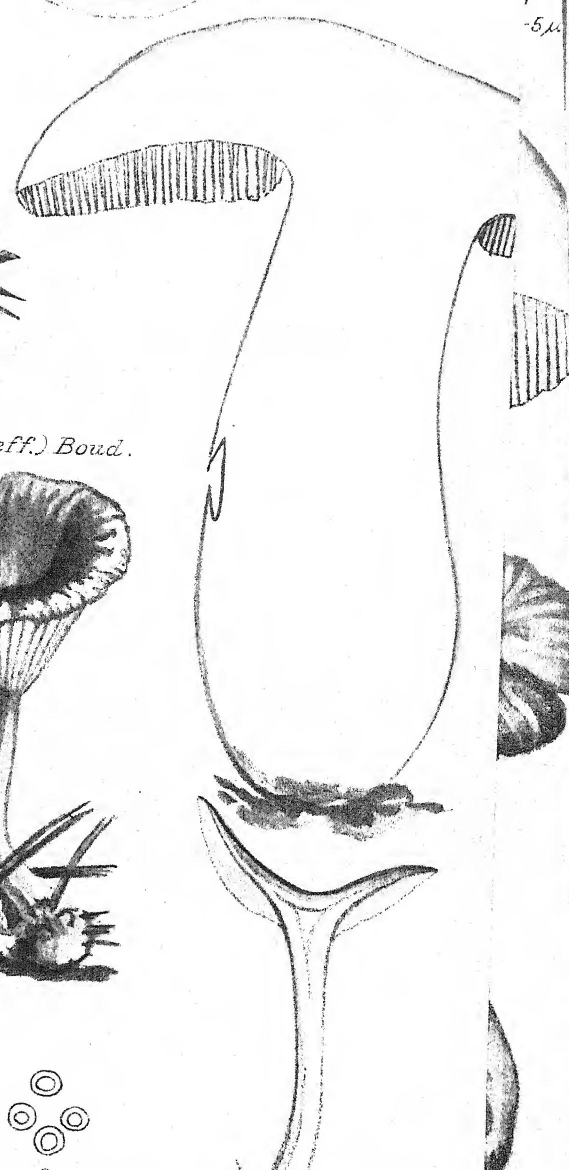
Resembling *Clitocybe expallens* but differing in the white margin of the pileus which is not cyathiform and the small, round spores.

Collybia phaeopodia (Bull.) Fr. Syst. Myc. I., 122; Hym. Eur. 113.

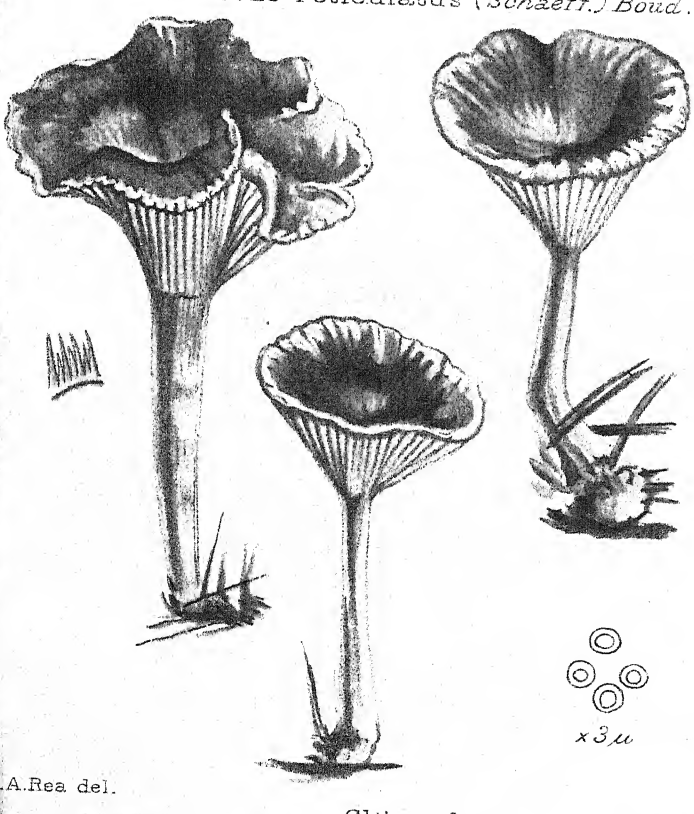
On bare soil in nettle-bed, garden corner, Sandsend, September, 1911. Naturalist (1912) 87.



Orifice of pores.



Boletus reticulatus *(Schaeff.) Boud.*



E. A. Rea del.

West, Newman chr.

Clitocybe incana *Quél.*

...ewman chr.

...la *(Vitt.)*

E. A. Rea del. West, Newman chr.

Hygrophorus (Limacium) squamulosus *Rea*. Boletus pinicola (*Vitt.*)

Mycēna Iris Berk. var. *caerulea* Rea.

This variety differs from the type in the pure blue colour of the pileus, the absence of blue fibrillae on the pileus and stem, and the grey stem white pulverulent at the apex. Spores white, elliptical, apiculate, 8-9 × 5μ.

Inside a hollow tree, Nantyffrith, Denbighshire, 17th May, 1910, Mr. W. B. Allen.

Hygrophorus (Limacium) squamulosus Rea. Clare Island Survey XIII., 26; and see plate 6.

Pileus 5-7 cm. wide, convex then expanded, subumbonate, glutinous, *floccosely squamulose* beneath the gluten, and *tomentose* at the incurved margin *over the base of the gills*, yellow olivaceous, fuscous at the centre. Flesh whitish becoming yellowish towards the lower half of the stem. Stem 6-8 cm. long, 1-2·5 cm. thick, equal or enlarged downwards, solid, glutinous, of the same colour as the pileus, white and mealy at the apex. Gills 5-10 mm. wide, sinuato-adnate, white, somewhat crowded, margin irregular. Taste agreeable. Smell pleasant. Spores white, globose, 3·5-4 × 3·5μ.

On the ground, Old Deer Park Wood, Mount Browne, county Mayo, 5th October, 1911.

At first sight somewhat resembling some forms of *Hygrophorus olivaceo-albus* but at once distinguished by the floccose squamules and tomentose margin of the pileus in which latter respect it resembles *Tricholoma album*.

Pluteus sororiata Karst. Myc. Fenn. III., 101 (1876).

On rotting branch, Mulgrave Woods, September, 1911. Naturalist (1912) 87.

Inocybe haemacta Berk. & Cke. var. *rubra* Rea.

This well marked variety differs from the type in the blood red colour of the pileus and stem which is only tinged verdigris green at the extreme base although the flesh is tinged with verdigris green for some considerable distance upwards.

On bare garden soil, Drumälan, Drumnadrochit, Inverness-shire, 17th September, 1908.

Inocybe abjecta Karst. Hattsv., 456; Sacc. Syll. V., 768; Massee Ann. Bot. XVIII., 480.

Pileus 1-3·5 cm. wide, subcampanulate or convex then expanded, sometimes subumbonate, brownish, becoming ochraceous-brown when dry, *everywhere covered with white fibrils*, disc with whitish subsquarrose squamules. Stem 2·5-4 cm. long, 4-8 mm. thick, solid, equal or fusiform, rather tough,

flexuous, pallid, *everywhere covered with white fibrous squamules*, apex white-pruinose. Flesh persistently white. Gills 6-7 mm. wide, adnate, ventricose in front, rather distant, pale cinnamon-olive, margin minutely flocculoso-crenulate at first. Spores ferruginous, pip-shaped, $14\text{-}16 \times 6\text{-}7\mu$, one guttulate, smooth. Cystidia scanty, ventricose, $50\text{-}65 \times 13\text{-}16\mu$.

Amongst sand, Culbin Sandhills, 17th September, 1912, Mr. A. D. Cotton.

Easily known by the white fibrils on the pileus and stem; it somewhat resembles *Inocybe maculata*, which has white adpressed squamules on the pileus.

Flammula carnosa Mass. British Fungi 290.

Growing in small fascicles on wood, found by Mr. A. Clarke, at the Castle Howard Fungus Foray, September, 1909. Naturalist (1912) 87.

Pluteolus Mulgravensis Mass. & Crossl.

Pileus somewhat fleshy, convex then expanded and umbonate, flocculose, becoming broken up into squamules, striate, grey, 5-6 cm. across; gills free, crowded, white then cinnamon, broad; stem stuffed, smooth, almost equal, base somewhat clavate, whitish, 4 cm. long; spores elliptical, ochraceous-brown, $9\text{-}10 \times 4\text{-}5\mu$.

On wood, Mulgrave Woods, September, 1911.

Differs from *P. reticulatus* and *P. aleuriatus* in the umbonate, striate cap becoming squamulose, and in the larger spores. Naturalist (1912) 85.

Cortinarius (Phlegmacium) turbinatus (Vent.) Fr. var. *lutescens* Rea.

Differs from the type in the yellow flesh of the pileus and stem.

Monk's Risborough, Buckinghamshire, 8th October, 1907, Rev. D. C. O. Adams.

Psaliota amethystina Quél. As. Fr. 1884; Fl. Myc. 71; Roz. & Rich. t. 18, f. 1-5.

Pileus 3-5 cm. wide, convex then expanded, umbonate, villose or fibrillose, *white* becoming either *rose* or *lilac* or *amethyst* coloured from the centre outwards. Stem 3-6 cm. long, 5-10 mm. thick, subbulbous at the base, stuffed with a silky pith, fragile, glabrous, white. Ring white, satiny. Flesh thin, white. Smell like *Psaliota silvicola*. Taste pleasant. Gills 6-7 mm. wide, ventricose, crowded, free, light grey then bay-brown.

Spores brownish purple, roundish oblong, $5\text{-}7 \times 4\mu$, one- to two-guttulate.

On the ground Haslemere, Surrey, September, 1910, Miss Phœbe Keef, and 19th August, 1912, Mr. E. W. Swanton. Easily distinguished in the Minores section by the white pileus becoming coloured from the centre outwards.

Hypholoma aellopum Fr. in Vet. Ak. Förh. 1873; Hym. Eur. 292.

On rotting stump, Mulgrave Woods, September, 1911. Naturalist (1912) 87.

Coprinus Friesii Quél. Jur. et Vosg. I., 129, t. 23, f. 5; Fl. Myc. 51; Fr. Hym. Eur. 331; Clare Island Survey Pt. XIII., 5, 9, 22.

Pileus membranaceous, ovoid, elliptical, then expanding, 1-2 cm. high and across, *floccosely pulverulent, snow white*, then striate, margin becoming greyish violet. Stem 2 cm. long, slender, *white*, pulverulent, swollen and floccose at the base. Gills free, narrow, crowded, white then violaceous and finally brownish-black. Spores bay, subglobose, 10μ diam., Clare Island and Belclare, H. C. Hawley.

Coprinus frustulosum Sacc. Myc. Ven. Spec. p. 35, t. 6, f. 10-14, from Atti della Soc. Ven.-Trent II.; Massee Revision of the Genus Coprinus, Annals of Bot. X, 168.

Pileus 3-6 cm. wide, 1cm. high, ovate then campanulate, *covered* up to the yellow umbo *with rosy red micaceous meal*. Stem 1·5-12·5 cm. long, conical then cylindrical, very brittle, *white*, glistening, hollow, smooth, mealy at the apex. Gills free. Spores $8 \times 6\mu$.

Caespitose amongst long grass near a post and under the shade of a Rhododendron, Inval, Haslemere, Surrey, 3rd September, 1912, teste Mr. E. W. Swanton.

Easily known by the rosy red micaceous meal on the surface of the pileus and the white glistening stem.

Boletus sphaerocephalus Barla. Ch. de Nice, t. 36; Quél. Fl. Myc. 415.

Pileus globose, 10-20 cm. wide, ochraceous yellow, more deeply coloured at the centre and sometimes tinged with brown, margin *light yellow*, with fragments of the ring attached. Flesh very thick, soft, watery, light yellow, *bluish* under the cuticle. Stem ventricose, 4-6 cm. long, 3-4 cm. thick, furrowed, tawny yellow becoming darker. Ring membranaceous, shaggy, usually evanescent. Tubes short, decurrent, orifice of pores

round or angular, bright yellow becoming tawny or brownish with age. Spores olivaceous, 8-10 x 3-4μ, biguttulate.

Boldre Wood, New Forest, Hampshire, C.R.

Boletus reticulatus (Schaeff.) Boud. Schaeff. t. 108; Boud. Soc. Bot. Fr. XXIII., 321; Icon. Myc. IV. 74 t. 146; and see plate 5.

Pileus 8-15 cm. and more broad, ochraceous yellow or greyish fawn, *finely tomentose*, fleshy, convex, often cracked in dry weather. Stem 6-9 cm. long, 4-6 cm. thick, often obese and a little constricted at the base, concolorous or paler, *reticulated to the base*. Flesh white, slightly coloured under the cuticle and at the base of the tubes, firm. Smell and taste pleasant. Tubes small, 1 mm. across, round, fairly long, free or almost free, greenish yellow. Spores olivaceous, oblong fusiform, one-three-guttulate, 13-18 x 4-5μ.

On the ground under Oaks, Wyre Forest, Worcestershire, 29th June, 1894. Swarraton, Hampshire, 22nd August, 1912, Rev. W. L. W. Eyre.

Easily distinguished from *Boletus edulis* by its paler, tomentose pileus and the stem reticulated to the base, it also generally occurs earlier in the year from the month of May onwards and but rarely in the autumn.

Boletus pinicola (Vitt.) Rea. Vitt. Fung. Mang. 170; and see pl. 6.

Pileus 9-20 cm. wide, convex, *rich chestnut colour* bordered with a narrow white line at the margin, fleshy, slightly viscid when moist, then *dry* and *floccose*. Stem 9-15 cm. long, 4-8 cm. thick, *concolourous*, rugose, slightly reticulate, subbulbous. Flesh white, reddish under the epidermis. Tubes 15-20 mm. long, adnate, ventricose, greenish, round or angular at their orifices, 1 mm. across. Spores olivaceous, fusiform, 1-3-guttulate, 15-18 x 4-5μ.

Amongst Pine needles, Inverey, Aberdeenshire, 2nd October, 1908. C.R.

Easily known amongst the Edules section by the dry, floccose, rich chestnut colour of the pileus and stem.

Polyporus sulphureus (Bull.) Fr. var. *albolabyrinthiporus* Rea.

This variety differs from the type in the white, labyrinthiform, torn pores and the flesh which is white from the first.

Inside a hollow Oak, Garnstone Castle, Herefordshire, 11th November, 1911, Mr. R. B. Johnstone.

Polyporus Boucheanus Klotzsch. Fr. Hym. Eur. 533; Lloyd Syn. Sec. Ovinus of Polyporus 86.

Pileus fleshy, plane or cyathiform, yellowish, with small squamae. Pores large, angular, decurrent, white. Stem short, pale, hirsute, excentric or often lateral. Spores $7 \times 12\mu$, hyaline, smooth.

On a dead branch, Swarraton, Hants, Rev. W. L. W. Eyre, teste Lloyd letter no. 42, 7. On an Oak, Looe, Cornwall, Dr. A. Adams, August, 1912.

"In fact, except as to its small size and pale stem, it is *squamosus* as to colour, flesh, pores, texture and spore," l.c. 86.

Polyporus tephroleucus Fr. Syst. Myc. I., 360.

On decaying, prostrate trunk, High Greenwood, near Hebden Bridge, August, 1911, Mr. James Needham. [Description given from fresh specimen] Naturalist (1912) 87.

Fomes euonymi Kalchb. Enum. II., 1232; Fr. Hym. Eur. 560. Kalchbr. Icon. Sel. Hym. 55, t. 35, f. 3.

On *Euonymus europaeus*, Grange Park, January, 1895, Rev. W. L. W. Eyre, teste Lloyd letter no. 42, 7.

Fomes australis Fr. Elench. 108; Nov. Symb. 47; Hym. Eur. 556.

Pileus 15-30 cm. and more across, deep umber chestnut or paler, convexo-plane, dimidiate, sessile, incrusted on the surface with a sticky resinous coating which finally dries up into tubercular ridges and becomes *laccate* and shining, margin sterile. Pores *elongate*, stratose, 2-3 cm. or more in length, reddish umber; orifice minute, round, at first white then fuscous. Flesh *very thin*, 2-4 mm. thick, soft, *deep umber chestnut*. Smell aromatic. Spores ochraceous, smooth, broadly elliptical, 10-12 $\times$ 7-8μ, one-guttulate, truncate at the base.

On *Ulmus glabra*, Benthall Works, Broseley, Salop, 3rd October, 1912, Mr. W. B. Allen.

Resembling *Fomes resinaceus* in its laccate pileus but differing in the very thin, deep umber chestnut flesh and the long pores which greatly exceed the thickness of the flesh at all stages.

Polystictus stereoides Fr. Syst. Myc. I., 369; Quél. Fl. Myc. 390.

Pileus coriaceous, effuso-reflexed, reniform, 2-3 cm. wide, rigid, *thin*, pubescent then glabrous, *greyish fuscous* with concolourous, depressed, narrow zones. Flesh creamy white. Pores medium size, unequal, *daedalioid*, *white*. Spores ellipsoid, 9μ long.

On a Fir stump, Swarraton, Hants, Rev. W. L. W. Eyre, teste Lloyd letter no. 42, 7.

Poria rancida Bres. Fungi. Trident. II., 96, pl. 208, f. 1.

On the ground among decaying pine needles, Mulgrave Woods, September, 1910. Specimen sent to C. G. Lloyd. "Poria rancida Bres. I have collected this same species in France on pine needles, and it was confirmed by Bresadola." Naturalist (1912) 87.

Peniophora aurantiaca Bres. Fungi Trident. II. 37, pl. 144, f. 2. Fungi Polon. 103. *Gloeopeniophora* v. H. et L. Beitr. (1908) 13.

On decaying wood, Mulgrave Woods, September, 1911. Identified by Miss Wakefield. Naturalist (1912) 88.

AURICULARIOPSIS R. Maire in "Recherches cytologiques & sur les Basidiomycètes" Bull. Soc. Myc. Fr. XVIII. (1902) 102.

This new genus is established for the reception of *Cyphella ampla* Lév. It is distinguished from *Cyphella* by its gelatinous consistency; some authors have wrongly transferred it to the genus *Auricularia* which has transversely septate basidia, but like the latter it shrivels up in dry weather and swells out in wet weather.

Auriculariopsis ampla (Lév.) R. Maire. *Cyphella ampla* Lév. Ann. Sc. nat. 1848, Fr. Hym. Eur. 662. *Auricularia Leveillei* Quél. Soc. Bot. Fr. 1870, Fl. Myc. 25. *Corticium flocculentum* Fr. Epicr. 559; Hym. Eur. 647.

Cups gelatinous, 4-12 mm. across when moist and fully expanded, thin, hoodshaped and inverted when dry, externally tomentose and pale in colour. Hymenium at length wrinkled and veined, fawn or bright brown, margin white. Spores boat-shaped, $8\text{-}10 \times 3\text{-}4\mu$, white, hyaline.

On a dead twig, Cambridge, 27th November, 1912, Mr. F. T. Brooks.

Cyphella villosa (Pers.) Quél. var. *stenospora* Bourdot & Galzin, Bull. Soc. Myc. Fr. XXVI., 225.

Minute 1·5-4mm. across, densely caespitose, hairs rough, pointed, $3\text{-}4\mu$ diam.; spores oblong, narrow, attenuated a little obliquely at the base, $8\text{-}10 \times 3\text{-}4\mu$. Basidia $15\text{-}18 \times 6\text{-}8\mu$.

On dead fronds of *Lastraea Filix-mas*, *Athyrium Filix-foemina*, &c., Inver, Dunkeld, Perthshire, 29th October, 1912, Mr. Charles McIntosh.

Clavaria Crosslandii Cotton in Naturalist (1912) 86.

Plants small, unbranched, isolated or fasciculate, greyish-white or grey, becoming darker with age; smell and taste

slight, pleasant. Clubs very slender, brittle, 2-3 cm. high, 1-3 mm. thick, pruinose, cylindrical, apex usually pointed. Stem hardly distinct. Flesh somewhat darker than the hymenium. Internal structure pseudoparenchymatous in transverse section, cells 5-8μ diam. Basidia 20-25 $\times$ 4-5μ, contents granular, sterigmata 4, erect. Spores hyaline, smooth, pip-shaped, 4-5 $\times$ 2·5-3μ.

Hab. In short grass. Mulgrave Woods, September 1910 and 1911. Comm. C. Crossland and W. N. Cheesman.

" The grey colour and small size which cannot fail to strike the observer, are good field characters by which to recognise the present species. From the drab-coloured *C. tenuipes* it is distinguished by its slender, brittle clubs, and from *C. fumosa* by its fasciculate instead of densely tufted habit. *C. acuta*, which the new species resembles in size, habit and texture, differs in the complete absence of the grey tinge. The microscopic characters confirm its title to specific distinction, the small basidium and spores marking it off from allied species. Amongst continental species *C. Crosslandii* most nearly approaches *C. affinis* Pat. et Doas. but this plant differs according to the published descriptions (no type is preserved), (1) in the distinct stem; (2) in becoming yellow on drying; (3) in the slightly punctulate spores. Though, on both occasions, a few clubs only were met with, the specimens agreed precisely, and were sufficient to show the essential characters."

Lycoperdon candidum Pers. Syn 146. *Lycoperdon separans* Peck New York Nat. Hist. Mus. Bot. Report XXVI., 73 (1874); Morgan " North American Fungi " Jour. Cincinnati Socy. of Nat. History April, 1891, 5. *Lycoperdon cruciatum* Rostk. in Sturm Deutschl. Fl. Bd. III., Hft. XVIII., 19, t. 8 (1844); Lloyd Myc. Notes 214; Naturalist (1906).

In a field on Haste Hill, Haslemere, 12th September, 1912, Mr. E. W. Swanton.

Geaster coronatus (Schaeff.) Schröt; Lloyd The Geastrae 31; *Geastrum quadrifidum* Pers. var. *minus* (Schmiedel) Pers. Syn., 133. *Geaster fornicatus* (Huds.) Fr. Sys. III., 12; Rabh. Krypt.-Fl. I., 912; Eng. & Prantl Pflanzen-familien I. Teil, abt. 2, 322.

Exoperidium fornicate, the mycelial layer forming an imperfect cup to which the arched segments of the fibrillose layer are loosely attached at the tips. The cup is not perfect as in *Geaster fornicatus* (Huds.) Berk. but the mycelium is so strongly developed that adhering dirt and pine-needles represent an ir-

regular mass rather than a definite cup. Segments of the arched fibrillose layer usually four, sometimes five, deeply cut, but relatively short as compared to the segments of *G. fornicatus*. Fleshy layer light coloured, partially adherent or sometimes entirely peeled off. Inner peridium oblong, tapering to a short pedicel at the base and to an acute mouth at the apex, *covered with minute granular particles*. Mouth definite. Spores globose, 4μ, rough.

In my paper on British Geasters last year I said this small fornicate Geaster, so abundant in the coniferous woods on the Continent, had never been recorded for Britain. On the 4th September, 1912, Miss E. M. Wakefield kindly sent me a specimen of this species for confirmation; it was from the Stroud Valley, Cotswold Hills, Gloucestershire. Subsequently Mr. J. Ramsbottom informed me that there are five specimens of this species in the Broome Herbarium gathered near Lucknam Grove, six miles west of Chippenham, Wiltshire, in October, 1867.

Galactinia brunneo-atra (Desm.) Boud.; Desm. Esp. nouv. (1836) 9; Sacc. Syll. VIII., 92; Boud. Hist. et class. Disc., 49; Icon. Myc. IV., 164, pl. 298; Journ. Bot. LI. (1912) 189.

On the sandy flats by the sea, from Formby to Ainsdale, Lancashire, Mr. H. J. Wheldon.

PUSTULARIA Fckl. Boud. Hist. et class. Disc., 52.

Ascophores cup-shaped, entire, pale, ochraceous or greyish, slightly tomentose rather than furfuraceous, sessile, rarely stipitate. Asci 8-spored, not turning blue with iodine. Spores elliptical, generally two-guttulate and accompanied with other granules. Paraphyses thin, hyaline or slightly coloured, scarcely thickened at the apex and not recurved. Growing on the ground.

Pustularia patavina Cke. & Sacc. Mycogr. f. 360; Sacc. Syll. VIII., 193; Boud. Icon. Mycol. IV., 189, pl. 340.

Ascophore ·5-1 cm. across, sessile, palish orange-ferruginous, whitish on the outside, disc cup-shaped, finally a little flattened, tomentose, ochraceous-ferruginous, margin crenate. Paraphyses linear, branched from the base, very slightly thickened at the apex, scarcely coloured. Asci not turning blue with iodine, slightly attenuated at the base, 200-260 × 15-20μ. Spores large, white, fusiform, smooth, two guttulate and accompanied with many granules, 24-26 × 10-13μ.

Amongst moss on an old charcoal bed at Kinfauns, Perthshire, July to September, 1912, Mr. James Menzies (teste Monsieur E. Boudier).

TRICHARIA Boud. Hist. et class. Disc. 57.

Ascophores cup-shaped, hairy, the hairs on the exterior generally brown, disc greyish or yellowish, rarely white. Asci fairly large, 8-spored, not turning blue with iodine. Paraphyses straight, a little branched. Spores smooth, rarely verrucose, not guttulate, sometimes containing some small granules that collect together. Growing on the ground.

Tricharia gilva Boud. in Cke. Mycogr. f. 406; Sacc. Syll. VIII., 185; Boud. Icon. Mycol. IV., 194, pl. 347; Nat. (1906) 8.

Ascophores greyish-fuliginous, scattered, rarely caespitose, 3-8 mm. across, sessile, cup-shaped becoming plane, clothed externally with septate, rough, pointed hairs, which are fasciculate at the margin and more flexuose at the base. Paraphyses linear, not thickened at the apex, uncoloured. Asci slightly attenuated at the base, cylindrical, 8-spored, not turning blue with iodine, $200 \times 15\text{-}16\mu$. Spores white, elliptical, scarcely granular inside, sometimes having when immature one or two small guttae which disappear, $13\text{-}16 \times 9\text{-}11\mu$.

On excavated clay soil amongst grass by the hedge side of a road in the suburbs of Perth, June and July, 1912, Mr. James Menzies.

Sepultaria foliacea (Schaeff.) Boud. Icon. Mycol. IV., 201, t. 359; Schaeff. t. 319.

Ascophore of medium or fairly large size, subterranean, globose and closed at first, then splitting up into large triangular segments like a Geaster, leaving a deep cup with the margin bent back in star-shaped pieces; disc dirty white slightly tinged with livid, externally clothed with wavy, flexuous, smooth, septate, brown hairs. Paraphyses simple or branched from the base, hyaline, septate, very slightly thickened at the apex. Asci large, attenuated at the base, not becoming blue with iodine, fairly wide, cylindrical, $380\text{-}400 \times 20\text{-}25\mu$. Spores ovoid, large, white, smooth, having one large gutta when mature accompanied with other granules when immature, $25\text{-}28 \times 15\text{-}18\mu$.

On sandy clay in and near an Old Red Sandstone quarry amongst the finer mosses near Perth, August to October, 1912, Mr. J. Menzies (teste Monsieur E. Boudier).

ANTHRACOBIA Boud., Hist. et class. Disc. 64.

Ascophores densely caespitose, small, orange coloured, clothed externally with fasciculate, short, obtuse hairs which make the margin under a lens appear black punctate. Asci cylindrical, narrower than in *Ciliaria*. Paraphyses thickened at the apex, becoming green with iodine. Spores elliptical, smooth, guttulate. Growing on charcoal.

Anthracobia nitida Boud. Hist. et class. Disc. 65; Icon. Mycol. IV., 219, pl. 388.

Ascophore 1-3 mm. wide, sessile, plano-convex, margin minutely dentate, orange-red, externally paler and granulose with fasciculate, short, obtuse, triseptate, fulvous hairs, 60-80 × 15μ. Asci cylindrical, 8-spored, attenuated at the base, 220 × 15μ. Paraphyses clavate, 8-10μ thick at the apex, filled with orange granules that become blue with iodine. Spores oblong-elliptical, white, biguttulate rarely accompanied by many small granules, smooth, 18-19 × 8-9μ.

Distinguished from *Anthracobia melaloma* by its brighter colour, smaller size, more clavate paraphyses and smaller spores with guttae less divided up. On charcoal heaps, especially on the fine ash left by the more complete combustion of the wood, July to October, 1912, Kinfauns, Perthshire, Mr. James Menzies (teste Monsieur E. Boudier). Densely caespitose and accompanied by *Anthracobia maurilabra* (Cke.) Boud.

Humaria rubens Boud. Bull. Soc. Myc. Fr. XII., 13, pl. III., f. 3; Icon. Mycol. IV., 224, pl. 396; Naturalist Jan. (1899), 27; Fungus Fl. of Yorkshire, 258.

Gregarious, usually amongst the finer mosses, over a large area on the Sidlaw Hills following the andesite rocks to the outcrop on the Dundee road near Perth, August and September, 1912, Mr. James Menzies (teste Monsieur E. Boudier).

Microglossum arenarium Rostr. Med. om. Gronland, 3, 606 (1891); Bot. Tidssk. XVIII., 76 (1892); Bot. Cent. Beiheft, 3 (1893). *Leptoglossum latum* Pk. Bull. Torr. Bot. Club XXII., 210 (1895). *Mitrula arenaria* (Rostr.) Mass. Ann. Bot. XI., 283 (1897). *Corynetes arenarius* Durand "The Geoglossaceae of North America" Annal. Mycol. VI., 417 (1908); Boud. Discomy. d'Eur., 87.

Plants single or caespitose, broadly clavate, black, 1-4 cm. high; ascigerous portion about half the total length, ·5-2 cm. broad, irregularly bent or contorted, compressed, furrowed, black; stem brownish-black or olive-black, pruinose or squamulose. Asci stout, clavate-cylindrical, apex narrowed, pore blue with iodine, 100-125 × 12-15μ; spores eight, biseriate above, uniseriate below, hyaline, smooth, cylindrical or cylindric-oblong, ends rounded, straight or curved, 25-35 × 6μ, contents for a long time continuous, finally becoming at least four septate (probably ten or more); paraphyses brown, cylindrical, septate, longer than the asci, 3μ thick below, the apices usually somewhat clavate, thickened and more or less curved.

In sand, September, Greenland, Labrador, Newfoundland,

Jutland (Denmark). A well-marked northern species characterized by the *long, conspicuous, brown paraphyses.*

Amongst sand, Culbin Sandhills, 15th and 17th September, 1912. I am greatly indebted to Miss E. M. Wakefield for her kind assistance in identifying this species.

Ombrophila nigripes (Pers.) Boud. *Helotium* Fr. Summa, 356. *Peziza* Pers. Syn., 661; Fr. Syst. Myc. II., 132.

Minute, subgelatinous, stipitate. Disc ·5-2 mm. across, plane then concave with the margin projecting, glabrous, pale whitish or yellowish. Stem 4-6 mm. long, ·5 mm. thick, becoming black in the basal two thirds, white at the apex. Asci cylindrical, $15\text{-}24 \times 3\text{-}4\mu$, 4-spored. Spores 1-seriate, hyaline, continuous, oblong, $5\text{-}6 \times 1{\cdot}5\text{-}2\mu$.

On dead leaves of *Picea excelsa* near Perth, 18th October, 1912, Mr. James Menzies.

Easily known by its long black stem and small pale disc.

I have to thank Mr. J. Ramsbottom for his kind assistance in determining this species.

Dasyscypha perplexa Boud. Hist. et class. Disc., 120; Icon. Mycol. IV., 298, pl. 510.

Ascophores minute, ·5-1 mm. across, stipitate, white, cup-shaped then plane, densely velvety, disc milk white becoming slightly ochraceous when dry; stem ·5-1 mm. long, concolorous, straight or flexuous, pubescent, hairs uncoloured, septate, cylindrical more or less flexuous, covered with evanescent granules, $100 \times 4\text{-}5\mu$, flesh white. Paraphyses fusiform, very pointed, septate at the base, internally granular, greatly exceeding the asci. Asci clavate, 8-spored, foramen immarginate, $40\text{-}45 \times 6\text{-}7\mu$. Spores fusiform-oblong, white, sometimes a little granular inside, $10\text{-}12 \times 2\text{-}3\mu$.

On dead root stocks and stems of *Dactylis glomerata* at Muirhall, near Perth, February and March, 1912, Mr. James Menzies.

PEZICULA Tul. Boud. Hist. et class. Disc. 159.

Ascophores small, bright coloured, almost immarginate, not urceolate, very slightly furfuraceous on the outside, generally stalked and more turbinate. Asci large, very slightly smaller towards the base, 6-8-spored, foramen not or only a little marginate. Paraphyses dichotomously branched upwards, clavate at the apex. Spores oblong, often curved, guttulate or filled with oily granules which disappear on germination, continuous at first then finally many-septate.

Growing on dead branches of trees and shrubs.

Pezicula eucrita Karst, Mycol. Fenn. I., 166; Boud. Icon. Mycol. IV., 330, pl. 559.

Small, ·5-1·5 mm. across, shortly stipitate, turbinate, thick, yellowish-ferruginous. Ascophores arising from a very short and thick stem, disc convex, slightly marginate, neither urceolate nor patelliform, sometimes only a little umbilicate, stem darker in colour, flesh concolorous. Paraphyses sparsely septate, slightly coloured, dichotomously branched, a little thickened at the apex. Asci large, broad, 8-spored, very slightly smaller at the base, foramen immarginate, $80\text{-}100 \times 17\text{-}20\mu$. Spores at first white then slightly coloured, oblong-cylindric, somewhat fusiform, straight or curved, guttulate and filled with granules, at first continuous then finally many-septate, after germination they lose all their guttae and granulations, $32\text{-}40 \times 7\text{-}9\mu$.

On bark of *Pinus sylvestris* Bidston, Cheshire, 12th January, 1912, and 16th August, 1912, Dr. J. W. Ellis.

Published 31*st May*, 1913.

DOLGELLEY SPRING FORAY.

9th to 13th May, 1913.

The fifth informal spring foray of the British Mycological Society was held at Dolgelley, Merionethshire, from Friday, the 9th of May, to Tuesday, the 13th of May, 1913. The members assembled on the Friday evening at the Ship Hotel, Dolgelley, and this constituted the headquarters of the Society for the meeting. Some nice examples of *Mitrophora hybrida* (Sow.) Boud. from the neighbourhood of Benthall, Salop, were brought to the foray by Mr. W. B. Allen.

On Saturday, the 10th of May, at ten o'clock, the members proceeded along the road leading to the Torrent Walk. Professor R. H. Yapp, M.A., of Aberystwyth, had arranged with the President (Mr. A. D. Cotton, F.L.S.) to bring over a contingent of his more advanced botanical students, and they succeeded in overtaking the members before the Torrent Walk was reached. Immediately on entering the Torrent Walk the President handed in a somewhat rare species of *Cordyceps*, but although immediate steps were taken to find some more specimens in the vicinity, only one other was obtained growing from the dead body of a dipteron. With Mr. J. Ramsbottom's kind assistance I was subsequently able to refer this species to **Cordyceps myrmecophila* Ces. In the boggy ground about the middle of the Torrent Walk some specimens of *Mitrula paludosa* Fr., *Pseudombrophila (=Geopyxis) tenuispora* (Cke. & Mass.) Boud. and *Arachnopeziza (Tapesia) aurelia* (Pers.) Fckl. were found. On a fallen Ash tree Mr. W. B. Allen boxed a few sporangia of *Hemitrichia Vesparium* (Batsch) Macbr. which has hitherto not been recorded for Wales.

On the following day a traverse was taken across the fields in the direction of Nannau House. In the yard of a farm house about mid-way some straw and potato haulm that had been used in an old turnip bury were carefully examined and rewarded Mr. W. B. Allen with two mycetozoa which are additions to the Welsh list, namely, *Physarum compressum* A. & S. and *Didymium nigripes* (Link) Fr. var. *xanthopus* (Ditm.)

* For an extended description of this species see p. 313.

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Lister. A few ascophores of *Sclerotinia sclerotiorum* (Libert) Schröt. were also obtained at the same place. About mid-day the members arrived at the entrance to the Nannau Woods and spread out in all directions in their search for fungi. Mr. W. B. Allen was again successful in securing a few examples of *Prototrichia metallica* (Berk.) Mass., previously only recorded for Wales from the Nantyffrith Valley, at the spring foray on the 17th May, 1910. Dr. J. W. Ellis found *Phoma quercella* Sacc. & Roum. on Oak galls *(Cynips Kollari)*. This is the first record of this species for Britain.

On Monday, the 12th of May, the members journeyed by the 9-45 a.m. train to Arthog. The woods on the right bank of the Arthog falls were first visited and the walk was continued to some young plantations adjoining the ridge from whence the ascent of Cader Idris is generally commenced. The orange ascophores of *Mitrula paludosa* Fr. were seen in great abundance, and Dr. J. S. Bayliss Elliott collected a few examples of the somewhat uncommon *Vibrissea truncorum* (A. & S.) Fr.

In the evening, at the business meeting of the Club, it was decided to hold the Whitsuntide week-end spring foray for 1914 in the Forest of Dean. Dr. O. V. Darbishire, B.A., Ph.D., of University College, Bristol, and Miss B. O'Loughlin, of Rocklands, Wallasey, Cheshire, were unanimously elected members of the Society. A hearty vote of thanks was accorded to Captain C. M. Richards, of Caerynwch, Dolgelley, and to Mr. A. R. Cox, agent to Colonel Scott, and the owners of the Nannau demesne, for kind permission to visit their estates.

On Tuesday, the 13th of May, at ten o'clock, a start was made from the headquarters in the direction of Penmaenpool, and a fair number of plants were found affected by *Puccinia Umbilici* Guép. and *Melampsorella Dieteliana* Syd. (= *Uredo Polypodii* Pers. p.p.). The woods adjacent to the railway station at Penmaenpool were carefully worked, but only *Collybia succinea* Fr. is worthy of note. Abergwynant valley was next visited and the return made to Dolgelley by the old Towyn road.

Messrs. C. J. Sharpe and Norman G. Hadden visited Fairbourne Sands on Wednesday, the 14th of May, and sent on specimens of *Collybia stipitaria* Fr., *Nidularia pisiformis* (Roth.) Tul. and *Ciliaria (Lachnea) trechispora* (B. & Br.) Boud. for verification. Over two hundred and sixty species of fungi were met with during the foray, and Mr. W. B. Allen has furnished me with the subjoined list of mycetozoa, including twenty-one species and two varieties.

COMPLETE LIST OF FUNGI GATHERED DURING THE FORAY.

A. = Arthog; *F.* = Fairbourne; *N.* = Nannau Woods; *P.* = Penmaenpool Road and the Abergwynant Valley; *T.* = Torrent Walk.

Lepiota amianthina (Scop.) Fr. *A.*
Tricholoma gambosum Fr. *N.*, melaleucum (Pers.) Fr. *F.*, *P.*
Clitocybe metachroa (Fr.) Berk. *N.*, ditopus Fr. *A.*, suaveolens (Schum.) Fr. (= fragrans (Sow.) Fr.) *T.*
Collybia velutipes (Curt.) Fr. *N.*, stipitaria Fr. (= Marasmius scabellus (A. & S.) Quél., Crinipellis stipitarius (Pers.) Pat.) *F.*, succinea Fr. *P.*, tenacella (Pers.) Fr. (= Collybia clavus (Schaeff.) Quél.) *N.*
Mycena galericulata (Scop.) Fr. *T.*, polygramma (Bull.) Fr. *T.*, alcalina Fr. *N.*, ammoniaca Fr. *A.*, filopes (Bull.) Fr. *P.*, amicta Fr. *A.*, clavicularis Fr. *P.*, discopus Lév. *A.*, hiemalis (Osb.) Fr. *P.*
Omphalia rustica Fr. *T.*, umbellifera (Linn.) Fr. *N.*, fibula (Bull.) Fr. var. Swartzii Fr. *A.*
Pleurotus septicus Fr. *T.*
Lactarius subdulcis (Pers.) Fr. *N.*
Androsaceus perforans (Hoffm.) Pat. *A.*, *N.*, epiphylloides Rea *P.*
Panus stypticus (Bull.) Fr. *A.*, *T.*
Lenzites betulina (Linn.) Fr. *T.*
Pluteus cervinus (Schaeff.) Fr. *A.*, *N.*, *T.*
Entoloma clypeatum (Linn.) Fr. *T.*
Nolanea pascua (Pers.) Fr. *A.*, *N.*, *T.*, var. umbonata Quél. *N.*
Claudopus variabilis (Pers.) W. G. Sm. *A.*, *P.*, *T.*
Pholiota togularis (Bull.) Fr. *A.*, *N.*, mutabilis (Schaeff.) Fr. *N.*, *T.*
Inocybe pyriodora (Pers.) Fr. *T.*, rimosa (Bull.) Fr. *P.*, asterospora Quél. *P.*
Naucoria melinoides (Bull.) Fr. *P.*, escharoides Fr. *T.*
Galera spartea Fr. *N.*, hypnorum (Schrank) Fr. *A.*, *T.*, var. sphagnorum (Pers.) Fr. *A.*
Tubaria furfuracea (Pers.) W. G. Sm. *N.*, *T.*
Crepidotus alveolus (Lasch) Fr. *N.*, *T.*
Cortinarius (Dermocybe) cinnamomeus (Linn.) Fr. *T.*
(Telamonia) brunneus (Pers.) Fr. *A.*, *N.*
(Hydrocybe) erythrinus Fr. *T.*

Psaliota comtula Fr. *F.*
Stropharia semiglobata (Batsch) Fr. *A.*, *N.*
Hypholoma sublateritium Fr. *T.*, capnoides Fr. *A.*, *T.*, epixanthum (Paul.) Fr. *T.*, fasciculare (Huds.) Fr. *N.*
Psilocybe foenisecii (Pers.) Fr. *P.*
Psathyra fibrillosa (Pers.) Fr. *N.*, *P.*, corrugis (Pers.) Fr. *P.*
Bolbitius fragilis (Linn.) Fr. *A.*
Coprinus cinereus (Schaeff.) Fr. *N.*, niveus (Pers.) Fr. *A.*, micaceus (Bull.) Fr. *T.*, radians (Desm.) Fr. *N.*, radiatus (Bolt.) Fr. *N.*, *on rabbit dung.*
Panaeolus sphinctrinus Fr. *P.*, campanulatus (Linn.) Fr. *A.*, *N*, *T.*, papilionaceus (Bull.) Fr. *T.*
Anellaria separata (Linn.) Karst. *P.*
Psathyrella gracilis (Pers.) Fr. *P.*
Polyporus brumalis (Pers.) Fr. *N.*, rutilans (Pers.) Fr. *T.*, betulinus (Bull.) Fr.
Fomes applanatus (Pers.) Wallr. *P.*, pomaceus (Pers.) Quél. *A.*, ferruginosus (Fr.) Massee *N.*, annosus Fr. *N.*
Polystictus perennis (Linn.) Fr. *T.*, versicolor (Linn.) Fr. *A.*, *N.*, *P.*, velutinus (Pers.) Fr. *T.*, abietinus (Dicks.) Fr. *T.*
Poria vulgaris Fr. *N.*, mollusca (Pers.) Fr. *T.*, vaporaria (Pers.) Fr. *A.*, *N.*, blepharistoma B. & Br. *N.T.*, farinella Fr. *A.*, *T.*
Daedalea quercina (Linn.) Fr. *N.*, *T.*
Merulius corium (Pers.) Fr. *A.*
Solenia anomala (Pers.) Fr. *T.*, var. ochracea (Hoffm.) Massee *N.*
Hydnum auriscalpium (Linn.) Fr. *N.*, niveum (Pers.) Fr. *N.*, argutum Fr. *T.*
Irpex obliquus (Schrad.) Fr. *A.*, *N.*, *T.*
Grandinia mucida Fr. *T.*, granulosa (Pers.) Fr. *N.*
Odontia fimbriata (Pers.) Fr. *T.*
Kneiffia setigera Fr. *N.*, *P.*, *T.*
Stereum hirsutum (Willd.) Fr. *A.*, *N.*, *P.*, sanguinolentum (A. & S.) Fr. *N.*, rugosum (Pers.) Fr. *T.*
Hymenochaete rubiginosa (Dicks.) Lév. *N.*, *T.*, corrugata (Fr.) Lév. *P.*
Corticium sanguineum Fr. *N.*, laeve (Pers.) Fr. *A.*, caeruleum (Schrad.) Fr. *A.*, *T.*, nudum Fr. *T.*, polygonium (Pers.) Fr. *N.*, serum (Pers.) Fr. *A.*
Peniophora quercina (Pers.) Cke. *T.*, cinerea (Pers.) Cke. *A.*, *T.*, velutina (DC.) Cke. *P.*, hydnoides Cke. & Mass. *T.*, incarnata (Pers.) Massee *N.*, *on Ulex.*
Cyphella villosa (Pers.) Karst. *A.*, capula (Holmsk.) Fr. *F.*, *P.*, muscigena (Pers.) Fr. *T.*
Auricularia (= Hirneola) Auricula-Judae (Linn.) Schröt. *F.*
Sebacina incrustans (Pers.) Tul. *N.*
Exidia glandulosa (Bull.) Fr. *N.*, *T.*, albida (Huds.) Bref. *A.*, *N.*, *T.*

Ulocolla foliacea (Pers.) Bref. *N*.
Tremella mesenterica (Retz.) Fr. *A*., *N*., *T*.
Dacryomyces deliquescens (Bull.) Duby *A*., stillatus (Nees) Fr. *N*., sebaceus B. & Br. *N*.
Ditiola (= Dacryopsis) nuda B. & Br. *N*.
Calocera stricta Fr .*P*.
Nidularia pisiformis (Roth.) Tul. *F*.
Cyathus striatus (Huds.) Pers. *N*.
Bovista nigrescens Pers. *P*., *T*.
Lycoperdon caelatum (Bull.) Fr. *N*., pratense Pers. (= hyemale (Bull.) Vitt., depressum Bon.) *T*.
Uromyces Ficariae (Schum.) Lév. *T*., Valerianae (Schum.) Fckl. *P*., Rumicis (Schum.) Wint. *P*., Scillarum (Grev.) Wint. *N*., Poae Rabh. *T*.
Puccinia fusca (Relh.) Wint. *T*., Umbilici Guép. *A*., *F*., *P*., *T*., Aegopodii (Schum.) Mart. *N*., Chondrillae Cda. (= prenanthis (Pers.) Wint.) *P*., *on leaves of Lactuca muralis*, Lampsanae (Schultz.) Fckl. *T*., Primulae (DC.) Duby *A*., Buxi DC. *N*., Caricis (Schum.) Rebent. *F*., *N*., Pringsheimiana Kleb. *P*., the aecidial condition *on leaves of Ribes Grossularia*, graminis Pers. *P*.
Phragmidium Fragariastri (D C.) Schröt. *T*., violaceum (Schultz.) Wint. *A*., *N*., *P*.
Coleosporium Senecionis (Pers.) Fr. *N*., *P*.
Melampsorella Dieteliana Syd. (= Uredo Polypodii Pers. pp.) *P*., *T*.
Urocystis Anemones (Pers.) Wint. *T*.
Sphaerotheca pannosa (Wallr.) Lév. *T*.
Nectria cinnabarina (Tode) Fr. *A*., coccinea (Pers.) Fr. *T*., episphaeria (Tode) Fr. *N*., muscivora B. & Br. *A*.
Hypomyces rosellus (A. & S.) Tul. *N*., *P*.
Cordyceps militaris (Linn.) Fr. *A*., *T*., myrmecophila Ces. *T*.
Chaetomium elatum Kunze *F*.
Leptospora spermoides (Hoffm.) Fckl. *A*., *P*.
Rosellinia aquila (Fr.) de Not. *N*., *P*., *T*.
Melanomma pulvispyrius (Pers.) Fckl. *T*.
Sphaerella maculiformis (Pers.) Auersw. *T*., Buxi Fckl. N., rumicis (Desm.) Cke. *P*., *T*.
Mycosphaerella Ascophylli Cotton, *on Algae, Barmouth, A. D. Cotton.*
Leptosphaeria Rusci (Wallr.) Sacc. *A*., doliolum (Pers.) Ces. & de Not. *N*.
Pleospora herbarum (Pers.) Rabh. *P*.
Eutypa lata (Pers.) Tul. *A*.
Valsa populina (Pers.) Wint. (= Cryptosphaeria millepunctata Grev.) *A*., *N*., *P*., *T*.
Melanconis stilbostoma (Fr.) Tul. *N*., *P*.

Diatrypella quercina (Pers.) Nke. *A.*, *N.*, *P.*, *T.*
Diatrype stigma (Hoffm.) de Not. *P.*
Hypoxylon multiforme Fr. *P.*, *T.*, rubiginosum (Pers.) Fr. *T.*, fuscum (Pers.) Fr. *N.*, *P.*, coccineum (Bull.) Fckl. *N.*
Daldinia concentrica (Bolt.) Ces. & de Not. *P.*
Ustulina vulgaris Tul.
Xylaria hypoxylon (Linn.) Grev. *A.*, *N.*, *T.*, polymorpha (Pers.) Grev. *N.*
Phyllachora graminis (Pers.) Fckl. *P.*, Junci (Fr.) Fckl. *A.*, *P.*, *T.*
Dothidella betulina (Fr.) Sacc. *N.*, *T.*
Rhopographus pteridis (Sow.) Wint. *N.*, *P.*
Aleuria (= Peziza) vesiculosa (Bull.) Boud. *A.*, *P.*
Galactinia (= Peziza) badia (Pers.) Boud. *N.*
Ciliaria (= Lachnea) scutellata (Linn.) Quél. *A.*, *T.*, trechispora (B. & Br.) Boud. *F.*
Cheilymenia (= Lachnea) theleboloides (A. & S.) Boud. *A.*, coprinaria (Cke.) Boud. *A.*, *P.*
Pseudombrophila (= Geopyxis) tenuispora (Cke. & Mass.) Boud. *A.*, *T.*
Mitrula paludosa Fr. *A.*, *N.*, *T.*
Cudoniella (= Leotia) acicularis (Bull.) Schröt. *T.*
Vibrissea truncorum (A. & S.) Fr. *A.*
Calycella (= Helotium) claroflavum (Grev.) Boud. *A.*
Coryne sarcoides (Jacq.) Tul. *A.*, *T.*, urnalis (Nyl.) Sacc. *P.*
Orbilia leucostigma Fr. *P.*, xanthostigma Fr. *A.*, *N.*, *T.*
Sclerotinia tuberosa (Hedw.) Fckl. *N.*, *T.*, Curreyana (Berk.) Karst. *A.*, sclerotiorum (Libert) Schröt. *N.*
Chlorosplenium aeruginosum (Oed.) de Not. *A.*, *N.*, *P.*, *T.*
Helotium herbarum (Pers.) Fr. *T.*, aureum (Pers.) Sacc. *N.*, fructigenum (Bull.) Karst. *T.*, cyathoideum (Bull.) Karst. *T.*, virgultorum (Vahl.) Karst. *P.*, calyculus (Sow.) Berk. *T.*
Dasyscypha virginea (Batsch) Fckl. *A.*, *T.*, nivea (Hedw. fil.) Karst. *A.*, *T.*, ciliaris (Schrad.) Sacc. *N.*, clandestina (Bull.) Fckl. *T.*
Lachnella (= Dasyscypha) corticalis (Pers.) Fr. *T.*
Trichoscypha (= Dasyscypha) calycina (Schum.) Boud.
Arachnopeziza (= Tapesia) aurelia (Pers.) Fckl. *A.*, *T.*
Hyaloscypha (= Dasyscypha) hyalina (Pers.) Boud. *N.*, *T.*
Micropodia pteridina (Nyl.) Boud. *T.*
Mollisia cinerea (Batsch) Karst. *N.*, *T.*, melaleuca (Fr.) Sacc. *N.*
Heterosphaeria patella (Tode) Grev. *A.*
Biatorella resinae (Fr.) Mudd *A.*
Encoelia (= Cenangium) furfuracea (Roth.) Karst. *A.*
Tympanis Fraxini (Schwz.) Fr. *T.*
Trochila Laurocerasi (Desm.) Fr. *N.*

Propolis faginea (Schrad.) Karst. *T.*
Stegia Ilicis Fr. *N.*
Colpoma quercinum (Pers.) Wallr. *A.*, *N.*, *T.*
Rhytisma acerinum (Pers.) Fr. *A.*
Lophodermium pinastri (Schrad.) Chev. *N.*, *T.*
Hysterographium Fraxini (Pers.) de Not. *T.*, curvatum (Fr.) Rehm. *N.*, *on Rubus.*
Frankiella Alni (Wor.) Maire *T.*
Cystopus candidus (Pers.) Lév. *A.*
Phoma occulta Sacc. *N.*, *on cones of Picea excelsa,* lineolata Desm. *A.*, *on cones of Larix europaea,* acuta Fuck., *N.*, *P.*, *T.*, quercella Sacc. & Roum. *N.*, *on Oak galls caused by Cynips Kollari.*
Ceuthospora Lauri Grev. *A.*
Septoria hederae Desm. *A.*, *N.*, *P.*, *T.* *A.*, *on Ruscus.*
Melasmia acerina Lév. *A.*
Dinemasporium herbarum Cke. *T.*
Trichoderma lignorum (Tode) Harz *N.*
Ovularia obliqua (Cke.) Oud. *P.*
Coniosporium olivaceum (Link) Sacc. *T.*
Verticillium candelabrum Bonord. *N.*
Torula pulveracea Cda. *P.*, herbarum (Link) Cda. *P.*
Hormiscium splendens (Cke.) Sacc. *A.*
Periconia byssoides (Pers.) Cda. *T.*
Cladosporium herbarum (Pers.) Cda.. *P.*
Helminthosporium scolecoides Cda. *N.*
Tilachlidium (= Stilbella) tomentosum (Schrad.) Lindau *P.*, *T.*
Sporocybe byssoides (Pers.) Fr. *A.*, *on leaves of Rhododendron.*
Epicoccum purpurascens Ehrnb. *N.*

*Mycetozoa.**

Physarum viride Pers. Nannau.
P. nutans Pers. Torrent Walk, Nannau, Penmaenpool. var. *leucophaeum* List. Penmaenpool.
P. compressum A. & S. Farmyard near Nannau, on rotting turnips. First record for Wales.
Craterium minutum Fr. Penmaenpool.
Leocarpus fragilis Rost. Torrent Walk, Penmaenpool.
Didymium difforme Duby. Nannau.
D. nigripes Fr. var. *xanthopus* List. Farmyard near Nannau. First record for Wales.
D. squamulosum Fr. Torrent Walk, Nannau, Penmaenpool.
Stemonitis fusca Roth. Abergwynant Valley.

* These were kindly determined by our fellow member Mr. W. B. Allen and verified by Miss Gulielma Lister, F.L.S.

Comatricha nigra Schr. Torrent Walk, Arthog, Nannau, Penmaenpool.
Enerthenema papillatum Rost. Arthog, Penmaenpool.
Reticularia Lycoperdon Bull. Nannau, Abergwynant Valley.
Lycogala epidendrum Fr. Abundant everywhere.
Trichia affinis de Bary. Torrent Walk, Arthog, Nannau, Penmaenpool.
T. varia Pers. Nannau.
T. decipiens Macbr. Abundant everywhere.
T. Botrytis Pers. Abundant everywhere.
Hemitrichia Vesparium Macbr. A small gathering in Torrent Walk. First record for Wales.
Arcyria denudata Sheldon. Abundant everywhere.
A. incarnata Pers. Penmaenpool.
Perichaena corticalis Rost. Torrent Walk, Nannau, Penmaenpool.
Prototrichia metallica Mass. A nice gathering at Nannau. Previously only recorded for Wales from the Nantyffrith Valley.†

† See Trans. Brit. Myc. Socy. III., 234, 238.

THE HASLEMERE FORAY.

22nd to the 27th September, 1913.

The seventeenth annual week's fungus foray of the British Mycological Society was held at Haslemere by invitation of the Haslemere Natural History Society. On Monday, the 22nd of September; 1913, the members assembled at the Educational Museum, East Street, Haslemere, and this constituted the headquarters for the meeting. At five o'clock Mr. E. W. Swanton, on behalf of the Haslemere Natural History Society, welcomed the following members on their arrival: Mr. A. D. Cotton, F.L.S. (President), Professor A. H. R. Buller, the Misses A. Lorrain Smith, Gulielma Lister, C. A. Cooper, A. Hibbert-Ware, K. E. Smith, B. K. Taylor, E. F. Noel, Mrs. J. S. Bayliss Elliott, Mr. and Mrs. F. T. Brooks, Mr. and Mrs. H. W. Harrison, Mr. and Mrs. C. H. Grinling, Dr. J. W. Ellis, Messrs. J. Ramsbottom, W. Norwood Cheesman, D. Mackenzie, C. J. Sharpe, N. G. Hadden, A. A. Pearson, M. A. Bailey, R. Finlayson, C. Otto Blagden, H. W. Jack, Leslie F. Newman, H. Hamshaw Thomas, and Mr. and Mrs. Carleton Rea.

Mr. H. W. Jack, B.Sc., B.A., University College, Cork; Mr. W. Rushton, A.R.C.S., D.I.C., Demonstrator in Biology at St. Mary's Hospital Medical School, Paddington, and Assistant Lecturer in Biology at the South Western Polytechnic Institute, 4, Rosenau Road, Battersea, London, S.W.; Miss K. E. Smith, 64, Compton Road, Nuneaton; and Dr. W. T. Elliott, D.D.S., L.D.S., F.Z.S., Arden Grange, Tanworth-in-Arden, Warwickshire, were then duly elected members. Later on in the evening the headquarters were again visited and the following exhibits were inspected: *Lycoperdon giganteum* (Batsch) Pers., *Lycoperdon depressum* Bonord., *Lentinus cochleatus* (Pers.) Fr., *Merulius tremellosus* (Schrad.) Fr., *Clavaria formosa* (Pers.) Fr., *Entoloma jubatum* Fr., *Lactarius spinosulus* Quél., *Lactarius controversus* (Pers.) Fr., *Boletus parasiticus* (Bull.) Fr., *Psaliota amethystina* Quél., *Mutinus caninus* (Huds.) Fr., *Clitocybe infundibuliformis* (Schaeff.) Fr., and *Pleurotus acerosus* Fr., all of which had been gathered by Messrs. A. D. Cotton and E. W. Swanton in the immediate vicinity of Haslemere. The President also brought *Sparassis crispa* Fr., *Hydnum nigrum* Fr. and *Hydnum zonatum* (Batsch) Fr. from Virginia Water.

Mr. W. B. Allen sent *Entoloma ameides* B. & Br. and *Leptonia serrulata* (Pers.) Fr. from the neighbourhood of Benthall. The Rev. W. L. W. Eyre forwarded from Swarraton *Clitocybe albocinerea* Rea.* Dr. J. W. Ellis displayed some nice drawings of *Phoma occulta* Sacc., *Phyllosticta Opuli* Sacc., *Cytospora foliicola* Lib., *Hendersonia Henriquesiana* Sacc. & Roum. (first British record), *Septoria Taraxaci* n.s.,* *Gloeosporium Lonicerae* n.s.* and *Ramularia plantaginea* Sacc. & Berl. (first British record). Mr. Raymond Finlayson exhibited a fine series of Mycetozoa mounted in a case that he had specially designed for the purpose. Mr. W. N. Cheesman brought *Diderma simplex* Lister from Yorkshire, and *Clathrus gracilis* (Berk.) Schlecht. from Australia. Mr. J. Denyer had sent *Geaster fornicatus* (Huds.) Berk. gathered at Godalming.

On Tuesday, the 23rd of September, the members motored from the Haslemere Town Hall, at ten o'clock, to Charlton Forest, in the county of Sussex. Permission to visit this estate had been kindly granted by the Duke of Richmond. Charlton Forest lies on high ground and consists chiefly of Beech and Oak. Early in the day Dr. Bayliss Elliott found an example of *Mycena crocata* (Schrad.) Fr., and it was subsequently gathered by many of the members. This fungus was first recorded as British by Knapp in his "Journal of a Naturalist," published in 1838, under the name *Agaricus infector*. The most noteworthy finds were *Amanitopsis nivalis* (Grev.) Sacc., *Lepiota metulaespora* B. & Br., *Lepiota alba* Bres., *Marasmius alliaceus* (Jacq.) Fr., *Marasmius globularis* (Weinm.) Fr., *Entoloma porphyrophaeum* Fr., *Leptonia incana* Fr., *Eccilia griseorubella* (Lasch) Fr., *Cortinarius (Phlegmacium) porphyropus* (A. & S.) Fr., *Cortinarius (Inoloma) bolaris* (Pers.) Fr., *Cortinarius (Hydrocybe) saturninus* Fr., *Coprinus picaceus* (Bull.) Fr., *Boletus candicans* Fr., *Boletus scaber* (Bull.) Fr. var. *niveus* Fr., *Polyporus tephroleucus* Fr., *Ecchyna Petersii* (B. & Br.), Pat. *Helvella lacunosa* (Afz.) Phill., and *Hypocrea alutacea* (Pers.) Tul. The walk was continued to Heyshot village and the motors re-entered for the homeward drive. In the evening, at nine o'clock, the President (Mr. A. D. Cotton, F.L.S.) took the chair and in feeling terms referred to the great loss that Science had sustained by the death of Sir Jonathan Hutchinson. This loss was all the more sad since Sir Jonathan Hutchinson had already placed his Educational Museum at their disposal for the foray and had always appreciated the work done by the Society. The Hon. Treasurer then presented the accounts for the past year up to the 31st July, 1913. These had not been published as usual in the programme for the foray because, owing to the limited accommodation available

* For description of this new species see p. 308.

in Haslemere, it was necessary to issue the same on the 7th of May last. These were received and adopted and are set out below.

Hon. Treasurer's Accounts of Income and Expenditure up to 31st of July, 1913.

1912 Cr.	£	s.	d.
31st July.—By balance brought forward	27	13	3
31st Decr.—By one year's Bank Interest	1	6	3
1913			
28th Mar.—By received Rev. W. L. W. Eyre, cost of plate 5	7	13	4
7th July.—By received of Mrs. Bayliss Elliott for extra plates	0	7	6
31st July.—By received for Copies of Transactions to this date	20	9	4
31st July.—By received Subscriptions to this date and £1 share of room at Forres from Cryptogamic Society of Scotland	45	2	0
31st July.—By received Donations to Printing Fund	9	11	6
31st July.—By received Miss G. Lister cost of plate 1 and reprints ...	4	14	0
	117	0	2

1912 Dr.	£	s.	d.
20th Septr.—To paid room at Moray Arms Hotel, Forres ...	2	0	0
21st Septr.—To paid tips Forres Foray...	1	0	0
1913			
13th Jany.—To paid Baylis & Son for Programmes Forres Foray, Membership Cards, &c. ...	1	18	0
14th April.—To paid Baylis & Son for Dolgelley Cards, Stamps, &c.		9	0
31st July.—To paid Baylis & Son for Printing Transactions, Reprints, Stamps, &c. ...	72	9	0
31st July.—To paid Baylis & Son for Haslemere Foray, Stamps, &c.	1	7	0
31st July.—To paid West, Newman & Co.	30	12	0
31st July.—To paid Stamps to this date	2	7	6
31st July.—To balance in hand	4	17	8
	117	0	2

Examined and found correct.
NORMAN G. HADDEN.
Aug. 6th, 1913.

The following donations have been made to the printing fund: Mr. D. Mackenzie, 5/-; Rev. D. C. Adams, 11/-; Dr. A. Adams, 10/-; Messrs. C. P. Bird, 5/-; D. A. Boyd, 15/-; Angus Grant, 5/-; Mrs. J. S. Bayliss Elliott, 5/-; Mrs. E. Brooks, 5/-; Professor M. C. Potter, 5/-; Mrs. H. C. I. Gwynne-Vaughan, 5/-; Messrs. A. Ramsay, 5/-; W. N. Cheesman, 10/-; Sir Thomas Acland (Bart.), 5/-; Miss Gulielma Lister, £1; Messrs. E. W. Swanton, 5/-; B. S. Ogle, 5/-; Rev. D. Paul, 5/-; Mr. H. Wager, 5/-; Rev. F. K. Clarke, 2/6; Sir Henry Hawley, £1. 0s. 0d.; Messrs. W. B. Allen, 5/-; B. P. Marmont, 5/-; C. J. Sharpe, 11/-; A. D. Cotton, 5/-; G. C. Hughes, 5/-; Dr. J. W. Ellis, 5/-; and Miss Hibbert-Ware, 5/-; Total, £9 14s. 6d.

The Hon. Treasurer further reported that the late Mrs. E. M. Robinson, of Saint Mary's Lane, Louth, had bequeathed a legacy of fifty pounds, subject to her mother's life interest in the same, to the Society, in memory of her late husband, John Branch Robinson, to be applied for the general purposes of the Society.

The following officers were unanimously elected for the ensuing year:—Professor A. H. Reginald Buller, D.Sc., Ph.D., F.R.S.C., President; Miss Gulielma Lister, F.L.S., Vice-President; and Mr. Carleton Rea, B.C.L., M.A., &c., Hon. Secretary

and Treasurer. After considerable discussion, Doncaster was selected as the centre for the autumn foray in 1914, the date* to be subsequently fixed to suit Professor A. H. R. Buller's convenience. Professor Buller was also appointed as delegate to represent the British Mycological Society at the Conference of Delegates of Corresponding Societies of the British Association to be held at Havre in the autumn of 1914. The Hon. Secretary reported that since the spring foray the following new members had been elected: Miss Dorothy Cayley, John Innes Horticultural Institution, Mostyn Road, Merton; Mr. H. V. Taylor, A.R.C.S., F.C.S., Inspector, Board of Agriculture, 4, Whitehall Place, London; Mr. and Mrs. H. W. Harrison, Harboro, Torrington Road, Liscard, Wallasey; Mr. George T. Spinks, B.A., Dip. Agri. Cantab, Trinity Hall, Cambridge; Mr. C. H. Grinling, 17, Rectory Place, Woolwich. They had to record their regret at the death of the Rev. W. Fowler, who had been a member of the Society since its formation. The total membership numbered one hundred and twenty, inclusive of the members inrolled on the previous day. The credit balance at the post office savings bank now amounted to the sum of ten pounds and two shillings. Miss E. R. Saunders, F.L.S., of Newnham College, Cambridge, and Mr. F. W. Hildyard, 77A, Lexham Gardens, Kensington, London, W., were then duly elected members.

On Wednesday, the 24th September, the morning was devoted to placing out on exhibition the specimens collected on the previous day. At noon the members departed in motors for Woolmer Forest. This Forest is in Hampshire and the portions known as the Forked Pond Enclosure and Longdon were worked. On the confines of the forest a gigantic specimen of *Gomphidius roseus* (Fr.) Quél. was obtained, and in close proximity *Boletus variegatus* (Swartz.) Fr. and *Boletus bovinus* (Linn.) Fr. grew in great profusion. The Forest was very damp and much overgrown with brambles but yielded some specimens of interest, namely:—*Russula Queletii* Fr., *Cortinarius (Inoloma) bolaris* (Pers.) Fr., *Entoloma Bloxami* Berk., *Omphalia hydrogramma* Fr., *Inocybe dulcamara* (A. & S.) Fr., *Russula virescens* (Schaeff.) Fr., *Lactarius theiogalus* (Bull.) Fr., *Tremellodon gelatinosum* (Scop.) Fr., *Coprinus stercorarius* (Bull.) Fr., *Stromatinia (=Sclerotinia) baccarum* (Schröt.) Rehm., *Rhizopogon rubescens* Tul., *Podosphaera myrtillina* (Schubert) Kunze.

In the evening, at nine o'clock, Mr. A. D. Cotton, delivered his presidential address entitled "Some suggestions as to the study and critical revision of certain genera of Agaricaceae" (see p. 224). Mr. F. T. Brooks, M.A., followed with

* Monday to Saturday, the 21st to the 26th September 1914.

THE BRITISH MYCOLOGICAL SOCIETY.

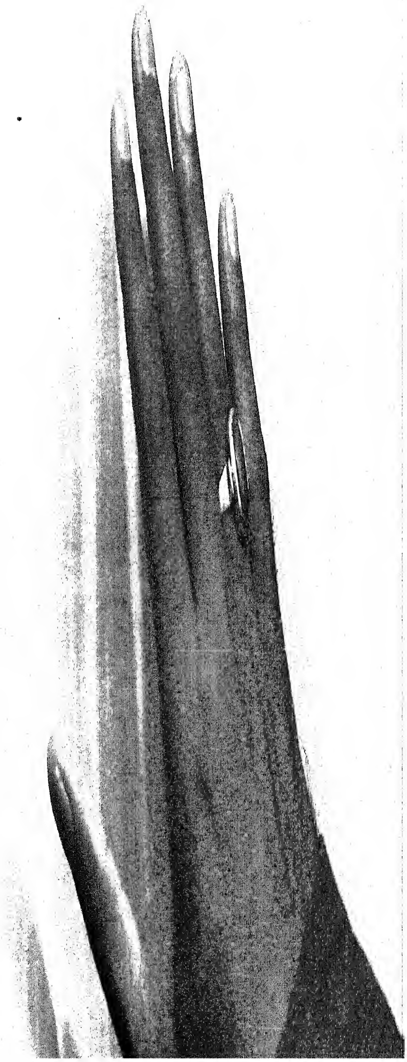
Haslemere Autumn Foray, 22nd to 27th September, 1913.

H. W. Harrison.

H. W. Jack. G. T. Spinks. E. Grinling. C. H. Grinling. J. Ramsbottom. W. N. Cheesman. E. Brooks. F. T. Brooks. J. W. Ellis. E. Harrison. K. E. Smith. A. Hibbert-Ware.

B. K. Taylor. E. F. Noel. E. A. Rea. J. S. Bayliss Elliott. A. H. R. Buller. A. D. Cotton (President). A. L. Smith. C. Rea (Hon. Sec.). G. Lister. C. A. Cooper. A. E. Swanton

C. O. Blagden. R. Finlayson. D. Mackenzie. N. G. Hadden. H. H. Thomas. A. A. Pearson. E. W. Swanton



"Observations on pure cultures of some Ascomycetes and Discomycetes" (see p. 239), and he handed round some of these cultures in illustration of his paper.

On Thursday, 25th of September, the morning was devoted to the critical examination of the specimens collected the previous day, and shortly before mid-day a photograph of the members, which is reproduced in this number of the Transactions, was taken by a professional photographer outside the entrance to the Educational Museum. At twelve o'clock punctually, the motors started for Rodborough Common, near Thursley, in Surrey. Lord Middleton had kindly granted permission for the members to explore the woods and commons in that neighbourhood. Rodborough Common had recently suffered from a serious fire in some parts, and consequently the carbonicolous fungi were abundant, including: *Flammula carbonaria* Fr., *Psathyra pennata* Fr., *Polystictus perennis* (Linn.) Fr., *Rhizina inflata* (Schaeff.) Karst., *Peziza (= Neotiella) Polytrichi* (Schum.) Boud. and *Pyronema (= Humaria) omphalodes* (Bull.) Sacc. The members spread out in all directions in the search for fungi and were finally reunited for tea at Elstead. The additions to the list were: *Omphalia maura* Fr., *Mycena Iris* Berk., *Russula azurea* Bres., *Russula incarnata* Quél., *Sparassis crispa* (Wulf.) Fr. and *Pistillaria micans* (Pers.) Fr. Miss Gulielma Lister subsequently sent on a mould which was determined to be *Chaetospermum chaetosporum* (Pat.) A. L. Sm. & Ramsb., and Dr. J. W. Ellis an undescribed Ascochyta on Sparganium which he proposed to call *Ascochyta Sparganii.*

In the evening, at nine o'clock, the President announced that Miss E. M. Wakefield, F.L.S., was unable to obtain leave of absence from Kew, and therefore he proposed to take her paper "Notes on the genera of Thelephoraceae" (see p. 301) as read. Miss Wakefield had also sent some type specimens of Thelephoraceae for their inspection, which had been exhibited on one of the tables in the Museum. The President showed a few slides illustrating some points dealt with on the previous evening. Professor A. H. Reginald Buller, D.Sc., Ph.D., F.R.S.C., then gave a lecture (illustrated with a fine series of lantern slides) on "The organization of the Hymenium in certain Hymenomycetes."

On Friday, the 26th of September, the morning was occupied in arranging the collections, and shortly after eleven o'clock the cars left for Woolmer Forest. On this occasion Lynchborough Park and Brimstone Enclosure were carefully searched and yielded the following: *Lactarius obnubilus* (Lasch) Boud., *Russula caerulea* (Pers.) Fr., *Cortinarius (Telamonia) gentilis* Fr., *Paxillus atrotomentosus* (Batsch) Fr., *Boletus pinicola* (Vitt.) Rea, *Polyporus Schweinitzii* Fr., *Polyporus tephroleucus*

Fr., *Hydnum Queletii* Fr., *Hydnum melaleucum* Fr., *Craterellus pusillus* Fr., *Sparassis laminosa* Fr., and *Cordyceps ophioglossoides* (Ehrh.) Link.

In the evening, the President took the chair at nine o'clock. Hearty votes of thanks were passed to the Duke of Richmond, Lord Midleton, and the War Office, for the kind permission they had given the members to visit their estates; and to the Trustees of the Educational Museum for placing the same at their disposal during the foray. Special thanks were accorded to their fellow member, Mr. E. W. Swanton, for all the trouble that he had taken in arranging the details of the programme for the foray and for the excellent way in which the same had been carried out. A resolution was passed expressing the hope that the valuable work that had hitherto been carried on at the Educational Museum might in the future be continued and developed on the lines and in the spirit of its founder, the late Sir Jonathan Hutchinson; and also recording the conviction of the members that it would be in the best interests of Science and Education if the maintenance of the Museum were placed on a permanent financial basis as a memorial to its founder. Mr. J. Ramsbottom, M.A., followed with his paper "Some notes on the history of the classification of the Discomycetes" (see p. 382). Five hundred and sixty-two species of fungi were collected dring the foray. The Hon. Secretary has to thank Mr. A. D. Cotton, Miss E. M. Wakefield, Miss A. Lorrain Smith, Mr. J. Ramsbottom, and Dr. J. W. Ellis for their kind assistance in preparing the subjoined list. Miss E. M. Wakefield adds a new British fungus to the list in recording *Coniophora Bourdotii* Bres. for the Haslemere Foray, but unfortunately no note was made as to where this specimen was gathered, and the same applies to the records of *Porothelium confusum* B. & Br., and *Eichleriella Kmetii* Bres.

COMPLETE LIST OF FUNGI GATHERED DURING THE FORAY.

Species found not generally distributed are marked *C.* = Charlton Forest, Sussex; *R.* = Rodborough Common, Surrey; *W.* = Woolmer Forest, Hampshire.

Amanita phalloides (Vaill.) Fr. *C.*, mappa (Batsch) Fr., muscaria (Linn.) Fr., rubescens Fr., spissa Fr. *Verdley Forest.*

Amanitopsis vaginata (Bull.) Roze, nivalis (Grev.) Sacc. *C.*, fulva (Schaeff.) W. G. Sm. *R.*, *W.*

Lepiota procera (Scop.) Fr. *R.*, gracilenta (Krombh.) Fr. *C.*, alba Bres. *C.*, metulaespora B. & Br. *C.*, cristata (A. & S.) Fr. *C.*, carcharias (Pers.) Fr., amianthina (Scop.) Fr. *R.*, haematosperma (Bull.) Boud.

Armillaria mellea (Vahl.) Fr. *C.*, mucida (Schrad.) Fr. *C.*, *R.*

Tricholoma resplendens Fr., flavobrunneum Fr. *R.*, albobrunneum (Pers.) Fr. *C.*, rutilans (Schaeff.) Fr. *C.*, *W.*, columbetta Fr. *W.*, terreum (Schaeff.) Fr. *R.*, argyraceum (Bull.) Fr. *C.*, saponaceum Fr., sulphureum (Bull.) Fr. *C.*, carneum (Bull.) Fr. *C.*, album (Schaeff.) Fr. *C.*, nudum (Bull.) Fr. *C.*, grammopodium (Bull.) Fr. *C.*

Clitocybe nebularis (Batsch) Fr., clavipes (Pers.) Fr. *R.*, *W.*, odora (Bull.) Fr. *C.*, rivulosa (Pers.) Fr. *C.*, cerrusata Fr. *C.*, candicans (Pers.) Fr. *W.*, dealbata (Sow.) Fr. *W.*, infundibuliformis (Schaeff.) Fr., inversa (Scop.) Berk. *C.*

Laccaria laccata (Scop.) B. & Br., var. amethystina (Vaill.) B. & Br.

Collybia radicata (Relh.) Berk. *C.*, platyphylla (Pers.) Fr. *C.*, maculata (A. & S.) Fr., prolixa (Fl. Dan.) Fr. *C.*, butyracea (Bull.) Fr., laxipes (Batt.) Fr. *Verdley Forest*, confluens (Pers.) Fr., conigena (Pers.) Fr. *W.*, cirrhata (Pers.) Fr. *W.*, tuberosa (Bull.) Fr. *W.*, tenacella (Pers.) Fr., dryophila (Bull.) Fr., aquosa (Bull.) Fr. *W.*

Mycena pelianthina Fr. *C.*, Iris Berk. *R.*, rubromarginata Fr. *W.*, pura (Pers.) Fr. var. multicolor Bres. *C.*, flavoalba Fr. *C.*, rugosa Fr., galericulata (Scop.) Fr., polygramma (Bull.) Fr. *C.*, atroalba Fr. *W.*, alcalina Fr.,

ammoniaca Fr. *C.*, filopes (Bull.) Fr. *C.*, plumbea Fr. *R.*, acicula (Schaeff.) Fr. *C.*, *R.*, haematopus (Pers.) Fr. *W.*, sanguinolenta (A. & S.) Fr., crocata (Schrad.) Fr. *C.*, galopus (Pers.) Fr., leucogala Cke. *R.*, *W.*, alba Fl. Dan. *W.*, epipterygia (Scop.) Fr. *W.*, rorida Fr. *W.*, tenerrima Berk. *C.*, *W.*, discopus Lév. *W.*, corticola (Schum.) Fr.

Omphalia hydrogramma Fr. *W.*, maura Fr. *R.*, pyxidata (Bull.) Fr. *R.*, umbellifera (Linn.) Fr. *W.*, grisea Fr. *C.*, fibula (Bull.) Fr. *Haslemere Museum grounds.*

Pleurotus acerosus Fr. *W.*, applicatus (Batsch) Berk. *W.*

Hygrophorus chrysodon (Batsch) Fr. *C.*, *Verdley Forest*, cossus (Sow.) Fr. *C.*, pratensis (Pers.) Fr., virgineus (Wulf.) Fr., niveus (Scop.) Fr., ovinus (Bull.) Fr. *W.*, coccineus (Schaeff.) Fr., miniatus Fr. *C.*, turundus Fr. *C.*, conicus (Scop.) Fr. *C.*, chlorophanus Fr. *C.*, psittacinus (Schaeff.) Fr. *C.*

Lactarius turpis (Weinm.) Fr. *W.*, pubescens Fr., blennius Fr. *C.*, pyrogalus (Bull.) Fr., chrysorheus Fr. *W.*, vellereus Fr. *C.*, deliciosus (Linn.) Fr. *C.*, *R.*, *W.*, pallidus (Pers.) Fr. *C.*, quietus Fr., aurantiacus (Fl. Dan.) Fr. *C.*, theiogalus (Bull.) Fr. *W.*, vietus Fr. *C.*, *W.*, rufus (Scop.) Fr. *W.*, glyciosmus Fr. *R.*, serifluus (D C.) Fr. *W.*, subdulcis (Pers.) Fr., cimicarius (Batsch) Phil. obnubilus (Lasch) Boud. *W.*

Russula nigricans (Bull.) Fr., adusta (Pers.) Fr., furcata (Pers.) Fr., rosacea (Pers.) Fr., depallens (Pers.) Cke. *W.*, caerulea (Pers.) Fr. *R.*, *W.*, drimeia Cke. *W.*, incarnata Quél. *R.*, virescens (Schaeff.) Fr. *W.*, lepida Fr. *R.*, rubra (DC.) Fr., vesca Fr., heterophylla Fr., consobrina Fr. *W.*, var. sororia (Larbr.) Fr. *R.*, fellea Fr. *C.*, *W.*, Queletii Fr. *W.*, emetica (Schaeff.) Fr. *C.*, azurea Bres. *R.*, ochroleuca (Pers.) Fr., fragilis (Pers.) Fr. var. nivea (Pers.) Cke. *W.*, var. violacea Quél. *C.*, *W.*, nitida (Pers.) Fr. *W.*, alutacea (Pers.) Fr. *C.*, lutea (Huds.) Fr.

Cantharellus cibarius Fr., aurantiacus (Wulf.) Fr., tubaeformis (Bull.) Fr. *C.*, *W.*

Nyctalis parasitica (Bull.) Fr. *W.*, asterophora Fr. *W.*

Marasmius peronatus (Bolt.) Fr., oreades (Bolt.) Fr., erythropus (Pers.) Fr. *W.*, globularis (Weinm.) Fr. *C.*, ramealis (Bull.) Fr., alliaceus (Jacq.) Fr. *C.*

Androsaceus rotula (Fr.) Pat. perforans (Hoffm.) Pat. *R.*, epiphylloides Rea *R.*

Lentinus cochleatus (Pers.) Fr.

Panus stypticus (Bull.) Fr. *W.*

Lenzites betulina (Linn.) Fr.

Pluteus cervinus (Schaeff.) Fr. *C.*, salicinus (Pers.) Fr. *C.*, chrysophaeus (Schaeff.) Fr. *C.*
Entoloma porphyrophaeum Fr. *C.*, Bloxami Berk. *W.*, jubatum Fr. *W.*, griseocyaneum Fr. *C.*, rhodopolium Fr. *R.*, sericeum (Bull.) Fr. *W.*, nidorosum Fr. *C.*
Clitopilus prunulus (Scop.) Fr. *C.*, vilis Fr. *C.*
Leptonia lampropus Fr. *C.*, serrulata (Pers.) Fr. *C.*, incana Fr. *C.*, chloropolia Fr. *C.*, sericella (Fr.) Quél. *C.*, *R.*
Nolanea pascua (Pers.) Fr., versatilis Fr. *W.*, mammosa (Linn.) Fr. *W.*, pisciodora (Ces.) Fr. *C.*
Eccilia griseorubella (Lasch) Fr. *C.*, *R.*
Claudopus variabilis (Pers.) W. G. Sm.
Pholiota erebia Fr. *Blackdown*, spectabilis Fr. *R.*, *W.*, mutabilis (Schaeff.) Fr., marginata (Batsch) Fr. *C.*
Inocybe dulcamara (A. & S.) Fr. *C.*, *W.*, pyriodora (Pers.) Fr. *C.*, flocculosa Berk. *R.*, cervicolor (Pers.) Quél. *R.*, *W.*, obscura (Pers.) Fr. *C.*, *W.*, rimosa (Bull.) Fr. *C.*, *R.*, asterospora Quél. *R.*, *Verdley Forest*, eutheles B. & Br. *C.*, geophylla (Sow.) Fr. *C.*, var. violacea Pat. *C.*
Hebeloma fastibile Fr. *C.*, mesophaeum Fr. *W.*, crustuliniforme (Bull.) Fr., longicaudum (Pers.) Fr. *C.*
Flammula carbonaria Fr. *R.*, *W.*, sapinea Fr. *R.* *W.*
Naucoria melinoides (Bull.) Fr. *C.*, semiorbicularis (Bull.) Fr. *R.*, *W.*, sobria Fr. *C.*, escharoides Fr. *R.*
Galera tenera (Schaeff.) Fr., rubiginosa (Pers.) Fr. *C.*, hypnorum (Schrank) Fr.
Tubaria furfuracea (Pers.) W. G. Sm., paludosa Fr. *W.*, crobulus Fr. *W.*
Crepidotus alveolus (Lasch) Fr. *W.*, mollis (Schaeff.) Fr. *C.*, calolepis Fr. *C.*
Cortinarius (Phlegmacium) triumphans Fr. *W.*, cyanopus (Secr.) Fr. *Verdley Forest*, infractus (Pers.) Quél. *C.*, multiformis Fr. *C.*, fulgens (A. & S.) Fr. *C.*, emollitus Fr. *C.*, porphyropus (A. & S.) Fr. *C.*
(Myxacium) arvinaceus Fr. *W.*, collinitus (Pers.) Fr. *W.*, elatior Fr., pluvius Fr. *Verdley Forest.*
(Inoloma) alboviolaceus (Pers.) Fr. *W.*, bolaris (Pers.) Fr. *C.*, *W.*, pholideus Fr. *R.*, penicillatus Fr. *W.*
(Dermocybe) tabularis (Bull.) Fr. *C.*, caninus Fr., azureus Fr. *C.*, *W.*, anomalus Fr. *C.*, *R.*, *N.*, lepidopus Cke. *C.*, *R.*, miltinus Fr., cinnabarinus Fr., sanguineus (Wulf.) Fr. *C.*, cinnamomeus (Linn.) Fr. and var. semisanguineus Fr.
(Telamonia) torvus Fr. *W.*, haematochelis (Bull.)

Fr. *R.*, hinnuleus (Sow.) Fr. *R.*, *W.*, gentilis Fr. *W.*, brunneus (Pers.) Fr. *C.*, incisa (Pers.) Fr. *W.*, hemitrichus (Pers.) Fr. *W.*, rigidus (Scop.) Fr. *W.*, paleaceus (Weinm.) Fr. *C.*, *R.*

(Hydrocybe) saturninus Fr. *C.*, castaneus (Bull.) Fr. *C.*, dolabratus Fr. leucopus (Pers.) Fr. *W.*, decipiens (Pers.) Fr., *C.*, *W.*, obtusus Fr. *C.*, *W.*, acutus (Pers.) Fr. *C.*, *R.*

Paxillus involutus (Batsch) Fr. *R.*, *W.*, atrotomentosus (Batsch) Fr. *W.*

Psaliota arvensis (Schaeff.) Fr., flavescens Roze *C.*, pratensis (Schaeff.) Fr., campestris (Linn.) Fr., sylvicola (Vitt.) Fr. *C.*, haemorrhoidaria Kalchbr. *R.*, comtula Fr. *C.*, amethystina Quél. *Haslemere.*

Stropharia aeruginosa (Curt.) Fr., albocyanea (Desm.) Fr. *W.*, inuncta Fr. *C.*, stercoraria Fr. *R.*, semiglobata (Batsch) Fr.

Hypholoma sublateritium Fr. *C.*, *R.*, *W.*, fasciculare (Huds.) Fr., pyrotrichum (Holmsk.) Fr., velutinum (Pers.) Fr., appendiculatum (Bull.) Fr., hydrophilum (Bull.) Fr. *W.*

Psilocybe ericaea (Pers.) Fr. *W.*, uda (Pers.) Fr. *R.*, *W.*, physaloides (Bull.) Fr. *R.*, semilanceata Fr., *C.*, *W.*, foenisecii (Pers.) Fr.

Psathyra corrugis (Pers.) Fr. and var. vinosa (Cda.) Mass. *R.*, pennata Fr. *R.*, *W.*

Bolbitius titubans (Bull.) Fr. *C.*

Coprinus comatus (Fl. Dan.) Fr. *C.*, atramentarius (Bull.) Fr. *W.*, picaceus (Bull.) Fr. *C.*, niveus (Pers.) Fr., micaceus (Bull.) Fr., radians (Desm.) Fr., radiatus (Bolt.) Fr. *Heyshott*, stercorarius (Bull.) Fr. (teste Buller) *W.*, plicatilis (Curt.) Fr., *R.*, *W.*

Panaeolus sphinctrinus Fr. *W.*, campanulatus (Linn.) Fr., papilionaceus (Bull.) Fr. *R.*

Anellaria separata (Linn.) Karst., fimiputris (Bull.) Karst. *W.*

Psathyrella gracilis (Pers.) Fr., atomata Fr., disseminata (Pers.) Fr. *C.*

Gomphidius roseus (Fr.) Quél. *W.*

Boletus luteus (Linn.) Fr. *R.*, *W.*, elegans (Schum.) Fr. *W.*, granulatus (Linn.) Fr. *W.*, bovinus (Linn.) Fr. *R.*, *W.*, badius Fr. *W.*, piperatus (Bull.) Fr., *Haslemere*, variegatus (Swartz) Fr. *W.*, chrysenteron (Bull.) Fr. *C.*, subtomentosus (Linn.) Fr. *W.*, parasiticus (Bull.) Fr. *Haslemere*, edulis (Bull.) Fr., pinicola (Vitt.) Rea *W.*, reticulatus (Schaeff.) Boud. *C.*, candicans Fr. *C.*, luridus (Schaeff.) Fr. and var. erythropus (Pers.) Fr. *R.*, laricinus Berk. *C.*, versipellis Fr. *W.*, scaber (Bull.) Fr. *R.*, *W.*, var. niveus Fr. *C.*

Fistulina hepatica (Huds.) Fr. *C.*
Polyporus Schweinitzii Fr. *W.*, squamosus (Huds.) Fr. *C.*, varius (Pers.) Fr. *W.*, tephroleucus Fr. *C.*, *W.*, lacteus Fr. *W.*, fragilis Fr. *C.*, *R.*, caesius (Schrad.) Fr. *W.*, mollis (Pers.) Fr. *W.*, rutilans (Pers.) Fr. *R.*, adustus (Willd.) Fr. *C.*, amorphus Fr. *W.*, betulinus (Bull.) Fr.
Fomes australis (Fr.) *C.*, pomaceus (Pers.) Fr. *R.*, annosus Fr. *C.*
Polystictus perennis (Linn.) Fr. *R.*, *W.*, versicolor (Linn.) Fr., abietinus (Dicks.) Fr. *C.*, *R.*, *W.*
Poria vaporaria (Pers.) Fr. *W.*, ferruginosa (Schrad.) Fr. *C.*, blepharistoma B. & Br. *W.*, terrestris (DC.) Fr. *Grounds of Haslemere Museum.*
Trametes gibbosa (Pers.) Fr. *C.*, rubescens (A. & S.) Fr. *R.*
Daedalea quercina (Linn.) Fr.
Porothelium confusum B. & Br. *Haslemere Foray.*
Merulius tremellosus (Schrad.) Fr. *C.*
Solenia anomala (Pers.) Fr. *C. W.*
Ptychogaster albus Cda. *W.*
Hydnum repandum (Linn.) Fr., Queletii Fr. *W.*, melaleucum Fr. *W.*, udum Fr. *W.*, ochraceum (Gmel.) Fr. *C.*, niveum (Pers.) Fr. *W.*
Irpex fusco-violaceus (Schrad.) Fr. *W.*, obliquus (Schrad.) Fr.
Phlebia merismoides Fr. *C.*, vaga Fr. *W.*
Grandinia granulosa (Pers.) Fr. *C.*, *W.*, mucida Fr. *W.*
Odontia fimbriata (Pers.) Fr. *C.*
Craterellus cornucopioides (Linn.) Fr. *C.*, pusillus Fr. *W.*
Sparassis crispa (Wulf.) Fr. *R.*, laminosa Fr. *W.*
Thelephora laciniata (Pers.) Fr. *W.*
Stereum hirsutum (Willd.) Fr., purpureum (Pers.) Fr., spadiceum (Pers.) Fr. *C.*, *W.*, rugosum (Pers.) Fr.
Hymenochaete rubiginosa (Dicks.) Lév. *W.*
Corticium lacteum Fr. *C.*, serum (Pers.) Fr. *R.*
Peniophora quercina (Pers.) Cke. *W.*, gigantea (Fr.) Mass. *R.*, cinerea (Pers.) Cke. *C.*, *W.*, velutina (DC.) Cke. *W.*, incarnata (Pers.) Mass. *R.*
Coniophora puteana (Schum.) Fr. *C.*, *R.*, *W.*, Bourdotii Bres. (new to Britain) *Haslemere Foray*, laxa Fr. *C.*
Eichleriella Kmetii Bres. *Haslemere Foray.*
Cyphella capula (Holmsk.) Fr. *W.*
Clavaria muscoides (Linn.) Fr. *C.*, cinerea (Bull.) Fr. *C.*, cristata (Holmsk.) Fr. *W.*, rugosa (Bull.) Fr. *W.*, formosa (Pers.) Fr. *near Haslemere*, abietina (Pers.) Fr. *Haslemere*, fusiformis (Sow.) Fr. *W.*, dissipabilis Britz. *R.*, *W.*, luteoalba Rea *R.*, *W.*, argillacea (Pers.) Fr. *C.*, *R.*, vermicularis (Scop.) Fr. *C.*, pistillaris (Linn.) Fr. *C.*

Pistillaria micans (Pers.) Fr. *R.*, quisquiliaris Fr. *W.*
Auricularia (= Hirneola) Auricula-Judae (Linn.) Schröt. *R.*
Ecchyna Petersii (B. & B.) Pat. *C.*
Sebacina incrustans (Pers.) Tul. *R.*, *W.*
Exidia albida (Huds.) Bref. *C.*
Tremella mesenterica (Retz.) Fr. *C.*, *W.*
Tremellodon gelatinosum (Scop.) Fr. *W.*
Dacryomyces deliquescens (Bull.) Duby *C.*, *R.*, *W.*, stillatus (Nees) Fr. *W.*
Calocera viscosa (Pers.) Fr. *W.*, cornea (Batsch) Fr. *C.*, stricta Fr. *C.*
Phallus impudicus (Linn.) Pers. *R.*, *W.*
Mutinus caninus (Huds.) Fr. *C.*
Sphaerobolus stellatus (Tode) Pers. *W.*
Bovista plumbea Pers. *C.*, *W.*
Lycoperdon perlatum Pers., depressum Bon. *C.*, *R.*, caelatum (Bull.) Fr. *C.*, *R.*, bovista (Linn.) Fr. *Haslemere*, pyriforme (Schaeff.) Pers., *W.*, echinatum Pers. *C.*, spadiceum Pers. *W.*
Scleroderma vulgare Hornem. *C.*, *R.*, *W.*, verrucosum (Vaill.) Pers. *W.*
Rhizopogon rubescens Tul. *W.*
Puccinia Calthae Link *R.*, Violae (Schum.) DC. *C.*, *R.*, *W.*, Malvacearum Mont. *Heyshott*, Centaureae Mart. *Haslemere*, Hieracii (Schum.) Mart., *C.*, *on Carduus*, Menthae Pers. *C.*, *R.*, obscura Schröet. *W.*, *on Luzula*, Caricis (Schum.) Rebent. *R.*
Triphragmium Ulmariae (Schum.) Link *W.*
Phragmidium Sanguisorbae (D.C.) Schröet. *C.*, subcorticium (Schrank) Wint. *C.*, *R.*, albidum (Kühn.) Ludw. *W.*, violaceum (Schultz) Wint. *C.*, *R.*
Coleosporium Campanulae (Pers.) Lév. *C.*, *on Campanula Trachelium.*
Pucciniastrum Vacciniorum (Link) Diet. *R.*, *W.*, Epilobii (Pers.) Otth. *R.*, *on Epilobium angustifolium.*
Melampsora Helioscopiae (Pers.) Cast. *C.*, Hypericorum (DC.) Schroet. *C.*, *on Hypericum hirsutum*, Larici-Caprearum Kleb. *Haslemere.*
Melampsoridium betulinum (Pers.) Kleb. *R.*
Sphacelotheca hydropiperis (Schum.) de Bary *W.*
Podosphaera myrtillina (Schubert) Kunze *W.*
Erysiphe tortilis (Wallr.) Fr. *C.*, *on Cornus sanguinea.*
Uncinula Aceris (DC.) Sacc. *C.*
Nectria cinnabarina (Tode) Fr., episphaeria (Tode) Fr. *C.*
Hypomyces aurantius (Pers.) Tul. *C.*, *W.*,
Hypocrea rufa (Pers.) Fr. *C.*, alutacea (Pers.) Tul. *C.*
Polystigma rubrum (Pers.) DC. *C.*
Claviceps microcephala (Wallr.) Fckl. *R.*, *W.*, *on Molinia caerulea.*

Cordyceps militaris (Linn.) Fr. *Haslemere Museum grounds*, ophioglossoides (Ehrh.) Link *W.*
Sordaria fimicola (Rob.) Ces. & de Not.
Podospora coprophila (Fr.) Wint. *W.*
Sporormia intermedia Auers., minima Auers.
Bertia moriformis (Tode) de Not. *C.*
Sphaerella Vaccinii Cke. *W.*, Buxi (Fckl.) Wint. *C.*
Pleospora herbarum (Pers.) Rabh. *W.*
Melanconis stilbostoma (Fr.) Tul. *C.*
Diatrypella quercina (Pers.) Nke. *C.*
Diatrype stigma (Hoffm.) de Not. *C.*, disciformis (Hoffm.) Fr. *C.*
Hypoxylon multiforme Fr. *C.*, coccineum (Bull.) Fckl. *C.*, fuscum (Pers.) Fr. *W.*
Daldinia concentrica (Bolt.) Ces. & de Not. *R.*
Ustulina vulgaris Tul. *R.*
Xylaria hypoxylon (Linn.) Grev.
Phyllachora graminis (Pers.) Fckl. *R.*
Dothidella betulina (Fr.) Sacc. *R.*, *W.*
Helvella crispa (Scop.) Fr. *C.*, *R.*, lacunosa (Afz.) Phill. *C.*
Macropodia (= Helvella) macropus (Pers.) Fckl. *C.*
Rhizina inflata (Schaeff.) Karst. *R.*, *W.*
Aleuria (= Peziza) vesiculosa (Bull.) Boud. *C.*, isabellina W. G. Sm. *W.*
Galactinia (= Peziza) badia (Pers.) Boud. *W.*, succosa (Berk.) Cke. *C.*
Otidea onotica (Pers.) Fckl. *W.*, cochleata (Linn.) Fckl, *R.*
Peziza (= Otidea) aurantia (Pers.) Fr. *R.*
(= Neotiella) Polytrichi (Schum.) Boud. *R.*
(= Humaria) rutilans Fr.
Ciliaria (= Lachnea) scutellata (Linn.) Quél. *W.*
Coprobia (= Humaria) granulata (Bull.) Boud. *R.*, *W.*
Ascobolus denudatus Fr., stercorarius (Bull.) Schröt. (= furfuraceus Pers.) *W.*, viridulus Phill. & Plow., glaber (Pers.) Phill.
Dasyobolus immersus (Pers.) Sacc.
Saccobolus Kerverni (Crouan) Boud., violascens Boud.
Ascophanus carneus (Pers.) Boud., microsporus B. & Br., sexdecimsporus (Crouan) Boud., lacteus (Cke. & Phill.) Phill.
Lasiobolus (= Ascophanus) equinus (Müll.) Karst. *W.*
Pyronema (= Humaria) omphalodes (Bull.) Fckl. (= confluens Pers.) *R.*
Leotia lubrica (Scop.) Fr. *C.*, *W.*
Calycella (= Helotium) citrina (Hedw.) Boud. *C.*, claroflava (Grev.) Boud. *W.*
Coryne sarcoides (Jacq.) Tul. *C.*

Polydesmia (= Belonidium) pruinosa (B. & Br.) Boud. *R.*
Orbilia xanthostigma Fr. *W.*
Stromatinia (= Sclerotinia) baccarum (Schröt.) Boud. *R.*, *W.*,
Phialea firma (Pers.) Boud. (= Ciboria ochroleuca (Bolt.) Massee) *W.*
Chlorosplenium aeruginosum (Oed.) de Not. *C.*
Helotium herbarum (Pers.) Fr. *C.*, aureum (Pers.) Rehm. *W.*, fructigenum (Bull.) Karst. *W.*, *on Acorns*, virgultorum (Vahl.) Karst. *W.*
Dasyscypha virginea (Batsch) Fckl. *W.*, Soppittii Massee *W.*
Trichoscypha (= Dasyscypha) calycina (Schum.) Fckl. *W.*
Hyaloscypha (= Dasyscypha) hyalina (Pers.) Boud. *W.*
Mollisia cinerea (Batsch) Karst., melaleuca (Fr.) Sacc. *W.*, lignicola Phill. *R.*
Tapesia fusca (Pers.) Fckl. *W.*
Heterosphaeria patella (Tode) Grev. *W.*
Trochila Laurocerasi (Desm.) Fr. *Haslemere.*
Propolis faginea (Schrad.) Karst. *C.*
Phacidium multivalve Kze & Schmidt *C.*, *R.*, *W.*
Stegia Ilicis Fr. *C.*, *R.*, *W.*
Hysterium conigenum (Pers.) Rehm. *R.*, *W.*
Colpoma quercinum (Pers.) Wallr. *C.*
Rhytisma acerinum (Pers.) Fr.
Mucor racemosus Fres.
Spinellus fusiger (Link) van Tiegh. *W.*
Sporodinia grandis (Link) van Tiegh.
Pilobolus crystallinus (Wiggers) Coem., longipes van Tiegh.
Elaphomyces granulatus Fr. *R.*, *W.*
Cystopus candidus (Pers.) Lév. *C.*
Phyllosticta Aceris Sacc. *C.*, betulina Sacc. *W.*, fraxinicola Curr. *C.*, Japonica Thüm. *C.*, *on Mahonia.*
Phoma Rusci Westend. *C.*, strobiligena Desm. *W.*, hysterella Sacc. *C.*, *on Taxus*, Mirbelii (Fr.) Sacc. *C.*, *on Buxus.*
Ascochyta Sparganii J. W. Ellis* *R.*, (new to science).
Asteroma Rosae Libert. *C.*
Septoria Fraxini Desm. *C.*, Rubi Westend. *C.*, *W.*, *R.*, Violae Westend. *C.*, *R.*, stemmatea (Fr.) Berk. *W.*
Leptothyrium acerinum (Kunze) Cda. *C.*
Oidium alphitoides Griff. & Maulb. *C.*, *R.*
Trichoderma lignorum (Tode) Harz *C.*
Sepedonium chrysospermum (Bull.) Fr. *W.*
Trichothecium roseum (Link) Grev. *R.*
Ovularia obliqua (Cke.) Oud. *C.*
Ramularia plantaginea Sacc. & Berl. *R.*, Plantaginis Ell. & Mart *C.*, Knautiae (Massal.) Bub. *R.*

* For description of this new species see p. 293.

Fusicladium dendriticum (Wallr.) Fckl. *C.*, *on Pyrus Malus*, *W. on Pyrus communis*
Cercospora Mercurialis Passer. *C.*
Macrosporium Brassicae Berk.
Stilbella erythrocephala (Ditm.) Lindau *W.*
Chaetospermum chaetosporum* (Pat.) A. L. Sm. & Ramsb. *R.* (new to Britain).
Aegerita candida (Pers.) Grev. *C.*

* For description see p. 328.

MYCETOZOA FOUND DURING THE FUNGUS FORAY AT HASLEMERE, SEPT. 23rd—26th, 1913.

By Gulielma Lister, F.L.S.

The localities visited during our Foray were: Charlton Woods, Sussex, on southward-facing slopes of the South Downs, where the trees were chiefly beech with a few ashes and an undergrowth of bramble; Woolmer Forest, Hants, consisting of pine and oak plantations with a little holly, and undergrowth of whortleberry and grass, broken by stretches of open peaty ground; Rodborough and Royal Commons, Surrey. The slopes of Rodborough Common are covered with short turf, bracken and heather with scattered clumps of Scotch Fir: we found no Mycetozoa here. On Royal Common and in the strip of woodland through which we passed to reach it the trees were mainly oak with some holly and thorns and with varied undergrowth.

In the accompanying list C. marks species found in the Charlton Woods, W. in Woolmer Forest, and R. on and about Royal Common. The following is the list of the forty-two species obtained:—

Ceratiomyxa fruticulosa (Muell.) Macbr. C., W. This is usually a summer species, and is not often found so late as the end of September.
Physarum nutans Pers. C., W., R.
P. viride (Bull.) Pers. W. On dead wood.
P. cinereum Link. W., R. On oak leaves.
P. virescens Ditmar. W., R. Found developing on wet moss

from sulphur-yellow plasmodium, in which stage it is fairly conspicuous; the mature greenish-yellow sporangia are easily overlooked.

Fuligo septica (L.) Gmelin. C., W., R. Both the usual yellow aethalia and a small white aethalium were found: the latter closely resembles some forms of *F. cinerea* Morgan, but is distinguished by the paler smaller spores, 7-8μ diam.

Craterium minutum (Leers) Fries. W., R. On holly leaves.

Diderma effusum (Schwein.) Morgan. W., R. On holly leaves.

D. simplex (Schröet.) Lister. W. Found on burnt peaty ground, both in mature condition and as bright chestnut-coloured plasmodium. This is the second English gathering of the species, the first having been made in July last on Keighley Moor, Yorks, by Messrs. F. White and Thos. Hebden. The brown clustered sporangia appearing amongst heather on open ground may often escape detection.

Didymium difforme (Pers.) Duby. R. Abundant on heaps of decaying plants.

D. Clavus (Alb. & Schw.) Rost. W., R. On dead holly leaves.

D. nigripes Fries. W. On dead holly leaves.

D. squamulosum Fries. W. On dead holly leaves.

Mucilago spongiosa (Leysser) Morg. C., W. On open turf and among dead leaves.

Stemonitis fusca Roth. C., W., R. On dead wood.

S. flavogenita Jahn. C., W. Among dead twigs.

Comatricha nigra (Pers.) Schröet. W., R. On dead boughs.

C. laxa Rost. W. On fallen pine boughs.

C. typhoides (Bull.) Rost. var. *heterospora* Rex. R.

Enerthenema papillatum (Pers.) Rost. W. On dead wood.

Lamproderma scintillans (Berk. & Br.) Morg. W. On dead holly leaves.

Cribraria argillacea Pers. W., R. On pine logs.

C. aurantiaca Schrad. W. On pine logs.

Dictydium cancellatum (Batsch) Macbr. W. On a pine log.

Licea flexuosa Pers. W. On pine stumps, abundant.

L. pusilla Schrad. W. Only a single small sporangium was found on a decayed pine log. The only other English locality from which this species has been recorded is Weybridge, Surrey, where it was found in October, 1912.

Tubifera ferruginosa Gmel. W. Several large clusters of sporangia were found within the hollow trunk of an oak.

Lycogala epidendrum (L.) Fries. C., W., R.

Trichia affinis de Bary. C., W. On dead boughs.
T. persimilis Rost. C. On dead wood.
T. varia Pers. C. On logs and fallen wood.
T. decipiens (Pers.) Macbr. C. On logs.
T. Botrytis Pers. C. A handsome form with black sporangia and brownish yellow spores and elaters, on a rotting beech log.
Oligonema nitens (Libert.) Rost. R. Found in some abundance on two oak boughs, lying on dead oak leaves at the bottom of a dry pond near Elstead. In the British Isles this species has been recorded before from Carlisle, Scarborough, Staffordshire, and Grampound, Cornwall. Both *O. nitens* and its near ally *O. flavidum* Peck have been found repeatedly on wood partially submerged in ponds.
Hemitrichia clavata (Pers.) Rost. C. On a beech log.
Arcyria ferruginea Sauter. W. On dead fir log.
A. incarnata Pers. W., R. On fallen oak boughs.
A. denudata (L.) Sheldon. C., W., R. On stumps.
A. cinerea (Bull.) Pers. W. On twigs.
A. pomiformis (Leers) Rost. W. On oak boughs.
A. nutans (Bull.) Grev. C., W. On dead boughs.
Perichaena corticalis (Batsch) Rost. On dead wood.

This list of 42 species of Mycetozoa compares favourably with that of 28 obtained at the previous Fungus Foray at Haslemere in 1905; although the number seems small when contrasted with our wonderful last year's record of 81 species from the Forres district, it has, except for that, been surpassed only by our record of 44 from the Wrexham district in 1910.

PRESIDENTIAL ADDRESS.

By A. D. Cotton, F.L.S.

SOME SUGGESTIONS AS TO THE STUDY AND CRITICAL REVISION OF CERTAIN GENERA OF THE AGARICACEAE.

Our gathering at Haslemere this week constitutes the 17th annual autumn meeting of the British Mycological Society. Since the foundation of the Society in 1896, autumn forays of a week's duration have been held every year, and during the last five years short spring meetings have been held in addition. Their object—the promotion and advancement of the study of our British Fungus Flora—is attained not only by the handling of a large number of fresh specimens, but also by mutual co-operation and help. The fungus season as generally understood is a short one, and consequently we who are engaged in the study of the larger fungi (especially the Agaricaceae) find these opportunities of examining fungi in company with fellow mycologists to be of the greatest value.

It is highly gratifying to be able to state that the British Mycological Society was never in a more flourishing condition, nor was the output of work by members greater or better in quality. For this satisfactory state of affairs most hearty thanks are due to our able Hon. Sec. Mr. Carleton Rea, whose whole-hearted interest in its welfare, only those who know something of the inner workings of the Society can fully appreciate.

The autumn forays have been held in some of the best and richest woods in England, and on three occasions members have been tempted as far north as Inverness-shire, whilst the woods of Wales and Ireland have also been explored. Haslemere is, however, the first centre to which we have been attracted a second time; the fine hunting and good sport we enjoyed here eight years ago having given it a front place in our memory. The late Sir Jonathan Hutchinson kindly placed his museum at our disposal on the occasion of our first visit, and gave us a hearty welcome, and had he lived he would doubtless have again been a distinguished visitor at our meetings. This year we are indebted to the Trustees of the Haslemere Museum, and we

have also the valuable assistance of Mr. E. W. Swanton to whose guidance the success of the former meeting was so largely due.

When we met here in 1905 we enjoyed the genial company and valued help of three eminent mycologists who are now no longer with us, Mr. Arthur Lister, Dr. C. B. Plowright, and Dr. W. Watson. The late Prof. Marshall Ward was moreover Vice-President the same year. The loss to the British Mycological Society of men such as these is incalculable. Marshall Ward's work and stimulating lectures have left their mark on mycology, and we are proud to record in our Transactions the results of some of his researches and also two presidential addresses. The works of our two other former presidents are in the hands of every mycologist, indeed it is not too much to say that Plowright's Monograph of the British Uredineae and Ustilagineae, and Lister's Monograph of the Mycetozoa rank amongst the most important works ever produced on systematic mycology. The former, published in 1889 and containing the results of years of labour and investigation, has held a unique place, and if now out of date this is only owing to the great advance since made in the subject. Of the place held by the Mycetozoa Monograph there is no need to remind this Society. The thoroughness of Mr. Lister's work is known to all, and by common consent, his treatise has been regarded as a model of accuracy and detail. With equal care and skill Miss Lister has prepared the second edition, and by its publication the Monograph is brought up to date and the Mycetozoa are now elaborated in a manner unrivalled in any group of the lower organisms with which the botanist has to deal. In connection with their work, it is a suggestive fact that both Plowright and Lister though eminently systematists were also greatly interested in the morphology and life-history of the organisms they studied.

With such examples as these before us, members of the British Mycological Society have no excuse to lag behind. Although few of us can expect to attain to their standard, their example of careful observation and perseverance is a great incentive to us all. There is plenty of scope in our own country, quite apart from the work of adjusting our floras to those of the Continent and America, or from working our collections of fungi from the colonies. A sound knowledge of the British Flora is of the greatest importance, and is, as we shall see later, from some points of view an urgent necessity.

I wish to speak this evening on the study of our British Agaricaceae, and to consider it from the standpoint of critical work with a view to the production of revised descriptions. My address may be divided into three parts, dealing with, (1) the need of such revision, (2) possible lines of investigation, and (3) some practical suggestions with regard to the methods of secur-

ing results. When dealing with a subject such as this, many questions come before us, but time permits only of our touching upon some of the more important.

1. With regard to the need of a more accurate knowledge, I will only mention two points. The first concerns our British plants. It is common knowledge that many species are either inadequately, or inaccurately described, whilst almost all groups are burdened with descriptions of "bad" species. The second point arises from this, and is connected with the naming of foreign collections. In national institutions, such as Kew and the British Museum, collections of fungi are constantly being received from abroad and from the colonies, and in dealing with these lack of precision in descriptions in our European floras is often painfully apparent.

To give a concrete example, we recently received at Kew a fine collection of plants from the Falkland Islands, and amongst the Cryptogams were a number of Agaricaceae. These proved to be mostly small pasture plants (species of Hygrophorus, Mycena, Galera, Stropharia, etc.), and were preserved in spirit accompanied by coloured drawings, sporecasts and notes. The other groups of Cryptogams could be fairly accurately determined, and it was possible to obtain an idea of the flora as a whole and of its geographical relationships. But the Agarics would for the most part defy the most daring mycologist, and this was the more provoking since they appeared to be extraordinarily similar to our own. Details as to size and texture are not so noticeable in dried or spirit material, and drawings however good can rarely give the range of colour in the same way as a series of fresh specimens. One had perforce therefore to rely rather largely on microscopic characters, but these features in mycological works are but scantily alluded to. One very ordinary looking Psathyrella, for instance, was found to possess three-pronged cystidia at the gill edge, but in the floras cystidia in the genus Psathyrella are scarcely mentioned, though on examination they are found to occur in almost all species. We see therefore that the identification of foreign specimens is hampered by the insufficiency of the description of our own species.

It is only right however to add that with foreign collections the difficulty is more often reversed, that is to say, the trouble is not with the poorness of the existing descriptions, but in the extreme difficulty of obtaining a correct idea of the specimen before you. It was the attempt to name Ceylon fungi from the imperfect knowledge gained from dried material and poorly executed drawings, that resulted in the "mycological chaos" so vividly described on more than one occasion by Petch (v. Trans. B.M.S. 1911, p. 340). But things have now improved, and spirit

material accompanies in many cases the dried specimens and drawings. With the help of this we can trace the affinity of the species more clearly though even now correct naming is often impossible. The chief asset in the spirit specimen is the preservation of form and of microscopic structure, and as it is on the latter that we largely rely the neglect of micro-characters in European handbooks is a great loss.

During the last few years collections of fungi have been sent to Kew from India, Burma, Malay States, Nigeria, Uganda, New Zealand, Queensland, New Caledonia and West Indies, and in all cases where fleshy Agarics are concerned great difficulty is experienced. Thus we find that these extra-European collections exert a reflex-action and throw us back on the study of our own flora. I say our own flora because it is representative, but to be correct the flora of all countries where pioneer mycologists were at work should be included.

Turning now for a moment to the Basidiomycetes as a whole, we find considerable progress has been made in the study of the group. German botanists have worked hard with the Uredineae, and as a British contribution we welcome the volume by Mr. W. B. Grove. The Gasteromycetes have also received attention, and the British species of Lycoperdon are now fairly sharply defined. The same may be said of the Clavarieae. Owing largely to the energies of Mr. C. G. Lloyd, the Polyporeae of the world are becoming much better understood, and with comparatively little critical work the British species could be easily settled. The Thelephoreae are also receiving attention and it is a source of great satisfaction to know that our member, Miss E. M. Wakefield is undertaking the revision of the difficult resupinate genera.

But when we come to the Agaricaceae the positon of affairs is different. The vastness of the family, and the transient nature of their sporophores, render their study exceptionally difficult, and it will be some time before we can expect more than revisions of genera and local monographs. The French have been active in producing such memoirs, critical and otherwise, but much further work is required. One of the few monographs of a genus is that on Inocybe by Mr. Massee (1904), and the lines adopted by him marked a distinct advance. Another genus on which we expect much light is Coprinus. From being one of the most perplexing we hope, as a result of Professor Buller's painstaking researches, shortly to find it one of the most thoroughly known and most accurately described. But with these and a few other exceptions our knowledge of the Agaricaceae has made little progress. A large number of species have been described in various countries, but we lack coherence and in many ways Fries' volume *Hymenomycetes*

Europaei, published all but 40 years ago, is still the best available. As I said at the outset my object this evening is to suggest some lines of work which we may profitably pursue, in the hope that by pulling together we may contribute something to the general advance, and this forms the second and main section of my address, to which we may now pass.

2. In systematic work of the nature indicated, two spheres of labour may be distinguished, the purely botanical and the bibliographical or literary, the latter dealing with questions of old names, synonomy, etc. Both spheres are necessary, and for success the worker must know something of each. Except, however, for a few passing remarks, we will confine ourselves to-night to the botanical side. With regard to macroscopic characters these are substantially the same as field characters, because being mostly lost on drying they must be ascertained whilst the plant is fresh. Microscopic characters on the other hand are to a certain extent capable of being preserved. These have in the past been largely left to the indoor man who as a rule deals also with the literary side. It is an aspect of the subject which appeals to him, since handicapped as he often is by living in a town, he values specially characters which will be recognisable in the dried or preserved specimen. It is to these microscopic characters that I wish to particularly refer, but I will first say a few words on field work.

Probably in no group of plants is the fresh specimen more important and the ordinary dried specimen of less value than in the fleshy Agaricaceae. The necessity of naming your plant within a few days or even hours after gathering is provokingly familiar to us all, and on account of this everyone recognises the need of studying the living plant. There is another reason why field work is important, and one which must not be overlooked by us who belong to the 2nd or even 3rd generation after Fries. That great master and all the older mycologists based their descriptions entirely on the morphological characters shown by the fresh specimen, and before we can use their names it is necessary to learn their ideas. Old names cannot be ignored, and any attempt to describe new species on microscopic characters, or even to amplify existing descriptions by this method, without a good training in the field and a sound knowledge of the views of older writers only leads to confusion. I wish to emphasise this point as the comparison of spores or other characters expressible in micro-millimetres has at times proved so fascinating that ordinary external features have been neglected.

But in these days of vegetation-surveys it is hardly necessary to press the importance of field work. One of the bye-products

of ecology is the very subject before us, namely, the renewed study of our common native plants. If systematists have shown ecologists the importance of a knowledge of species and varieties, ecologists have driven systematists to reinvestigate their own flora. This applies equally to fungi, though so far mycologists have not received much of the wholesome and stimulating criticism of the keen ecologist. There is no reason, however, why ecology should not be extended to fungi, and that their taxonomy should not be investigated from a more comprehensive standpoint. The various conditions under which growth takes place should be recognised and the effect noted. The chief factors at work may be grouped together under two heads, edaphic and climatic, that is those concerned with soil and climate respectively. If such subjects as these be included in the investigation it will at once be seen that a large field opens before the systematic mycologist. The edaphic conditions consist of not only the master factors of geological formation, and phanerogamic vegetation, but others such as the acidity, porosity, and water content of the soil, the presence of humus or certain mineral salts. The most important climatic factors are those of temperature and rainfall, three aspects of which have to be considered, namely, those inducing what are termed weather, season, and climate. Other factors such as drying winds or salt-laden breezes likewise have their effect. These two classes of factors, the edaphic and climatic, also determine in the main the phanerogamic vegetation, hence they exercise in addition an indirect, though very important, influence on the mycological flora and vegetation.

In mentioning these factors it is not the ecological *analysis* of our fungus flora that I have before me, interesting as that would be, but the study of the effect of habitat on the individual, in other words, of the form assumed by the same species under different conditions. We are all familiar with the short hillside form, and the tall, long-grass form of certain Agarics, and in the case of well-known species recognise the difference as being the result of habitat. But in other cases the influence of conditions may not have been appreciated, and we have one species under two or even three names. To eliminate these "bad" species much field work is required, and also an intimate knowledge not only of the species itself but of the genus as a whole.

Another field character not to be overlooked in systematic work is that on which Mrs. Carleton Rea lays so much stress namely, the question of age and a good series of specimens. For an accurate description we must know all stages of the plant. The scurfiness of the stipe and pileus is well known to vary with the age, and a succession of colour-changes may take place. The

latter is not confined to the pileus but is also found in the gills, and it may, as Mr. Rea has lately shown us in the case of Hypholoma, be of more value than has hitherto been supposed. A good series of specimens is specially important when the question of a veil or ring has to be considered, and I have a strong suspicion that amongst such genera as Hypholoma and Psilocybe several plants which are now separated on the ground of the presence or absence of a veil are really forms of one species in different stages of development. But here again the influence of ecological factors, notably weather-conditions, must not be disregarded. Other points of a similar nature will suggest themselves, but enough has been said to show that in this work of revision first-hand critical work in the field is essential.

We will now turn to the microscopic characters. It may be well to begin by assuring any member who is suspicious as to the use of these for the larger fungi, that no serious changes will be advocated, nor is it likely that any great "splitting" will follow. It is undeniable that Agarics possess certain well-defined micro-characters, which may or may not be of diagnostic value. What we wish to do is to ascertain their nature for each species so as to amplify our descriptions; then to test their value, and make use of them when possible for systematic purposes. We do not expect them to supplant field characters, but to supplement them, though experience has shown that in many groups micro-characters have been of the highest value.

At the Baslow meeting of this Society Professor René Maire gave an elaborate account of his method of investigating the genus Russula. He dealt with the microscopic structure in great detail, and his paper is invaluable for anyone wishing to take up that line of investigation. It would doubtless be instructive to examine in similar detail the histology of the gill in all genera, but for our present purpose it is hardly necessary, and we will confine our attention to the study of the spores, cystidia, and the structure of the gill-edge.

Taking the spore first, as being most commonly examined and generally admitted to be of importance, we find surprising differences in the descriptions given in our floras. The usual points to be noted are the form, size, colour and sculpturing. More than one member of the Society has remarked that it would be worth while to publish revised lists of the spore-characters of the Agaricaceae. On attempting this, however, a difficulty arises which is both instructive and encouraging. If two or three members compare notes, it will be found that as regards well-known species their records are in tolerable agreement, but with little known and questionable species there is often great diversity. This shows, on the one hand that the spores of the well-known species are fairly constant, and on the other, that these

bodies may possibly be of service in helping to separate those species which are doubtful or similar to each other in external appearance. My own work has been almost confined to the purple and black spored sections, and in those groups it is unquestionable that in certain genera the spores form a most useful diagnostic character.

There can be little doubt that wrong determinations account for a large percentage of discrepancies as to spore-characters, but other factors may be partly responsible, and some of these I will take the opportunity of briefly pointing out. In the first place there is the question of *age*. Immature spores differ considerably from those which are ripe, hence only mature spores, that is those which fall readily from the gill should be examined. In the second place we have the selection of *typical* spores. As a rule it is best to give the dimensions of an average spore, and to state also the ordinary variations. Odd spores which are exceptionally large or small are abnormal, and should not be included in the description. Thirdly, certain spores show *characteristic variability*. Just as some Agarics are singularly constant in the field and others singularly variable, so in some species the spores are particularly uniform, and in others, particularly inconstant. Allowance therefore, must be made for this. The variation liable to occur under these three headings is familiar to all, but there is a fourth source of error which I believe is not so generally recognised, namely that due to the presence of *ill-nourished* spores. Such spores are apparently infrequent in nature, and occur under special conditions, the chief of which is probably sudden desiccation. I hope to speak about this for a few minutes to-morrow evening. So much for causes of variation. If the pitfalls alluded to be avoided, there should be small danger in the use of spores, and I have no hesitation in saying that with a little experience, their value will be appreciated.

We now pass on to cystidia. Much light has lately been thrown both on the structure and function of these bodies, and, incidentally, on their value to the systematist. Their presence on the gills of Agarics is much more frequent than is generally supposed, and they occur in one form or another in nearly all genera. In the dark spored section it is quite the exception to find species in which they are absent, and Mr. Massee, who has been working for some time with the Leucosporae, tells me that they are surprisingly numerous in that section also. In the genus Coprinus, the cystidia are large and conspicuous, and Buller was the first to demonstrate that they acted as spacing agents or props to keep the gills apart. In other genera they are smaller and serve an entirely different purpose. Knoll investigated several widely separated members of the Agaricaceae,

and he believes that the small hair-like cystidia, or trichomes as he terms them, are really hydathodes, that is bodies serving for the secretion of superfluous moisture. The exudation takes place at the apex of the trichome, and in some species the cell-wall at this point swells to such an extent, that it forms a colloidal solution in the excreted water. In alcohol material this is sometimes very clearly seen. I have noticed it frequently in *Tubaria furfuracea* and in several species of Stropharia.

Cystidia are not quite so easy to examine as spores, and a certain amount of practice and technical skill is required. My own method is to harden the material in alcohol, and then cut tangential sections through the pileus. This gives transverse sections of the gills, when the form and number of the trichomes are well seen, though a little dissection, and pressure on the cover-slip, may render things even clearer. In a surface view of the gill these structures are often so delicate as to be invisible. As far as I can judge at present, the trichomes on the gill surface are not so generally useful to the systematist as the spore, or gill margin; but in some cases they are without doubt of a certain value.

This brings us to our third micro-character, namely the gill-margin. René Maire recognises three types, homomorphic, heteromorphic, and sub-heteromorphic. Homomorphic when the edge is of the same structure as the surface or lateral face of gill; heteromorphic when, owing to the presence of cystidia or other elements, it is different; and sub-heteromorphic when there is a preponderance of hairs or cystidia which are already present in small quantity on the surface.

Now it is a remarkable fact that when cystidia are present on the gill-surface, the fringe on its margin is very often composed of trichomes of the same type. In some cases moreover the scurf on the stipe, and occasionally on the pileus also, is formed of precisely similar outgrowths. I observed this point myself in some species of Galera, and have since noticed that it had been recorded by more than one writer. Into the meaning of the fact I do not enter, but it is an exceedingly convenient one for the mycologist, as with a little experience of the genera in hand, the type of the surface cystidium will be evident by simply examining the gill-margin.

The lantern slides to be exhibited to-morrow show the gill-edge of some of our well-known Hypholomas and Stropharias, and you will notice the variety in the size and form of the trichomes. Now if our floras had some record of this gill-margin it would confer a great boon to mycologists dealing with collections sent from abroad. The species I shall show you are all common well-recognised forms, but there can be little doubt that in others equal variety obtains. This is the case in certain

species of Galera, Naucoria and Psathyrella, as to which, when one requires definite distinguishing features, it is very difficult to obtain uniformity of opinion. I can confidently recommend the gill-edge as worthy of study, and feel sure that it will prove of value for systematic purposes. As however the subject is still in its infancy it is important not to base conclusions from insufficient material, or to be unduly hasty in publishing results. It may be added that the small short gills appear at times to be less supplied with trichomes than those of full length, and, that it is always necessary to examine young or fairly young plants. On old gills the trichomes usually wither away, whilst if kept under close, moist conditions (e.g., in a closed vasculum) abnormal processes of various kinds are apt to develop.

This concludes my remarks on the microscopic features. For the sake of convenience we have considered the subject separately from that of field characters, but if any good work is to result, both lines of study must be followed. With regard to microscopic characters these doubtless vary as do all others, but it is quite possible that just as changes in macroscopic features may be connected with differences in habitat, so variations detected by the microscope may be found to be correlated with certain definite external conditions.

3. Having considered the need that exists for critical investigation, and surveyed some of the lines of study which may be profitably pursued, it remains to discuss for a few minutes the methods of work and co-operation likely to give the best return.

A certain amount of work has been done, but the results are hardly satisfactory. Critical remarks on field characters are of general occurrence in the literature, and scattered observations on microscopic features are plentiful enough. In papers on morphology and development, there is often an excellent account of the gill-structure. Local floras sometimes supply spore-measurements, and occasionally also notes on cystidia. But when we come to look at these observations from our present standpoint, we are repeatedly pulled up by discrepancies so great that they compel us to doubt, not so much the correctness of the observation, as the correctness of the identification. This difficulty meets us everywhere, the only exception being in the case of a monograph or a revision. Of papers specially devoted to micro-structure perhaps the most comprehensive is a series of useful contributions by Frau Paula Demelius, of Prague, in each of which she deals with a number of species belonging to various genera and groups. This method appears at first sight to be one by which the detailed description of all species might in time be acquired. But in practical working, it is somewhat disappointing. Frau Demelius finds her observations often differ from those of

other writers, and my own in some cases differ from both. It is quite certain that the discrepancies are not entirely due to variation, but, partly and probably largely, to wrong determination, or, to a different understanding of a given species in different countries. If we were content with noting only generally recognised plants, this diffused method of dealing with all species just as they come to hand would be useful, and, to those engaged in colonial mycology, of real value. But there is a tendency to exceed this limit and then the work is practically useless.

There can be no question that the only really satisfactory method is the monograph. It is slow, but the results are much more likely to be sound. Known species become better understood, and little known and unknown plants gradually find their proper position. A comprehensive monograph of any genus of the Agaricaceae is of course at present out of the question, but the monographic principle,—concentration on a given genus or group—can be followed, and we should at least be able to produce a series of critical revisions of British species.

It would no doubt be desirable to include continental forms, but for this the time has hardly come, and for the present it seems safer, and indeed preferable, to confine our research to native species.

Our Society has plenty of latent energy, and I am quite sure that with a little co-operation and mutual stimulus such revisions could perfectly well be produced. We have already learned the value of co-operation in systematic mycology. Berkeley, Cooke, Plowright, and Lister, all had a whole band of correspondents who assisted them by supplying specimens from all parts of the country. The general response to the appeal for material of Clavaria and later for resupinate fungi, shows how willing to help members of the Society are when research work is in hand. Lloyd's work on Puffballs and Polypores was carried out in the same way. But if assistance was needful for such groups, how much more is it necessary for the short-lived fleshy Agaric. Prof. Buller has made a beginning with Coprinus and we have an opportunity of helping him to bring that genus to order. With regard to other genera there seems to be no reason why a few that are familiar and fairly simple, should not be taken in hand at once.

The mycologist responsible for a given revision must be prepared to work out the necessary microscopic structure, and to undertake the literary work, but if it is to be carried out in the right spirit, he must above all things be a field man. In addition to drawings and notes, a dried and spirit collection of numbered samples should be made. Other members would help as opportunity permitted, and in all cases they should supply data as to ecological conditions and as to the field characters of the speci-

mens forwarded. In the later stages of the work a good library will be essential, and sooner or later the assistance of that at Kew or the British Museum will be required.

Such are the suggestions I would lay before you. General work should still be encouraged, but if we are to advance, we must specialize, and it seems to me that the production of some of these much needed revisions of British species would be one of the most suitable and at the same time most useful pieces of work which our Society could carry out.

THE FRUIT-BODY MECHANISM OF BOLBITIUS.

By Professor A. H. R. Buller, D.Sc.,; Ph.D.; F.R.S.C.

In treating of the Hymenomycetes several writers have referred to the resemblances which exist between the genera Bolbitius and Coprinus. Thus Massee* says: "In the Ochrosporae, the genus Bolbitius agrees with Coprinus in the ephemeral existence of the species, in the soft deliquescent gills, and also in most frequently growing on dung or in places where dung abounds." Referring to Bolbitius the same writer† also says: "Very delicate and fragile, remarkable amongst the Ochrosporae for the gills dissolving into mucus, and in this respect analogous with Coprinus among the Melanosporae and Hiatula among the Leucosporae."

The genus Bolbitius was included by Hennings‡ along with Coprinus in the group Coprineae which was defined as follows: "Fruit-bodies with soft flesh (weich-fleischig), composed of an even web of hyphae, stipitate. Lamellae of different lengths, alternating in a regular manner. Hymenium composed of isolated protuberant basidia which are separated from one another in a regular manner by paraphyses. Lamellae and usually also the cap, deliquescent."

In previous publications, I§ have described the fruit-body

* G. Massee. British Fungus-Flora, Vol. I., 1892, p. 304.

† Ibid. Vol. II., 1893, p. 203.

‡ P. Hennings, in Engler and Prantl's Pflanzenfamilien, Teil 1, Abteil. 1**, 1897, p.204. The translation here given is mine.

§ A. H. R. Buller. Researches on Fungi; Longmans, Green & Co., London, 1909, chap. XIX.; also Annals of Botany, Vol. XXIV., 1910, pp. 613-629; and these Transactions, 1911, pp. 348-350.

mechanism of the Coprini. I showed that the so-called deliquescence is a process of autodigestion which plays an essential part in the liberation of the spores. In the genus Coprinus:

(1) The gills are very thin,
(2) The gills are parallel-sided or subparallel-sided.
(3) The gills are not positively geotropic.
(4) Usually the hymenium on one side of a gill at maturity looks slightly downwards, and that on the other side slightly upwards.
(5) The spores ripen in succession from below upwards on each gill.
(6) The spores are discharged in succession from below upwards on each gill.
(7) Autodigestion proceeds from below upwards on each gill and removes those parts of the gills which have become spore-free and which, if they continued in existence, would become mechanical hindrances to the fall of the remaining spores.

All the facts just given are correlated with one another. In the genus Coprinus the ripening and discharge of the spores from below upwards on each gill, and the autodigestion from below upwards on each gill are special arrangements which permit of successful spore-discharge from parallel-sided, non-geotropic gills.

After the fruit-body mechanism of Coprinus had been elucidated, it seemed to me advisable to investigate the fruit-bodies of a Bolbitius with a view to finding out whether or not their arrangements for producing and liberating spores were the same as in Coprinus. Accordingly, I examined the living fruit-bodies of *Bolbitius flavidus* Bolt,* obtained from a grassy field where horses had been grazing. This paper will be devoted to a brief statement of the results of my observations.

In the fruit-bodies of the Bolbitius I found that:

(1) The gills are very thin,
(2) The gills are not parallel-sided but are acutely wedge-shaped in cross-section.
(3) The gills are positively geotropic.
(4) Every part of the hymenium on any gill in a normally oriented fruit-body looks more or less downwards.
(5) The spores do not ripen in succession from below upwards on each gill.
(6) The spores are not discharged in succession from below upwards on each gill.

* My specimens resembled in appearance those of Plate 689 in Cooke's Illustrations. The fungus there represented, according to Massee, is *Bolbitius flavidus* Bolt. *Vide* his British Fungus-Flora, Vol. II., pp. 204 and 205.

(7) Autodigestion does not proceed from below upwards on each gill; it does not have any relation to spore-discharge but is a *post-mortem* change.

It is clear that the special mode of spore-production and spore-discharge which we find in Coprinus does not exist in Bolbitius. In particular the liquefaction of the gills which is such an essential feature of the fruit-body mechanism of Coprinus, has nothing to do with spore-discharge in Bolbitius. In Coprinus the autodigestion takes place whilst the pileus is still actively shedding spores, whereas in Bolbitius the turning of the pileus into a brown mucus takes place when spore-discharge has ceased and the whole pileus is exhausted and dead.

The fruit-body mechanism of Bolbitius resembles in its main features that of a Mushroom. The gills are wedge-shaped in cross-section and are positively geotropic. This ensures that in a normally oriented fruit-body every part of the hymenium looks more or less downwards. Correlated with this fact we find that every small area of the hymenium (every square mm.) produces and liberates spores at one and the same time. On any one small area, a series of basidia ripen and shed their spores in succession.

From the fore-going remarks we may conclude that the arrangements for spore-production and spore-liberation in Bolbitius are essentially different from those of Coprinus.

The hymenium on the sides of the gills of Coprinus consist of:

(1) Basidia which are dimorphic: long basidia and short are interspersed among one another.

(2) Large and well-developed paraphyses which form a continuous system and which separate the basidia from one another.

(3) Large cystidia, present in some species but absent in others.

The hymenium on the sides of the gills of the Bolbitius consist of:

(1) Basidia which are monomorphic: the basidia are all of the same length and cannot be divided into two sets, long and short.

(2) Large and well-developed paraphyses which form a continuous system and which separate the basidia from one another.

(3) Cystidia are absent.

Coprinus and Bolbitius have very similar paraphyses which are remarkable for their high development. On the other hand the two genera differ markedly in their basidia. The dimorphism which we find in Coprinus is absent in Bolbitius. Further, on any very small area of the hymenium of Coprinus at maturity, all the basidia have full-sized and practically ripe spores on them at

one and the same time. On a similar area of the hymenium of Bolbitius, adjacent basidia are not in about the same state of development at any one time. Here the basidia develop and discharge their spores in succession.

In their general field characteristics the Bolbitii do bear a general resemblance to the Coprini. Among these characteristics may be mentioned:

(1) Thin flesh and relatively large gills.
(2) Relatively long stipes.
(3) Delicacy and ephemeral nature of the fruit-bodies.
(4) Deliquescence of the gills and pileus flesh.
(5) Fruit-bodies coprophilous.

However, if instead of merely considering the more obvious characters we study the whole organization of the fruit-bodies, taking into account both microscopic and macroscopic characters, then I think we must conclude that the two genera stand far apart. Their fruit-body mechanisms for the production and liberation of spores are essentially different, and one could not be converted into the other without important structural and physiological changes.

OBSERVATIONS ON PURE CULTURES OF SOME ASCOMYCETES AND BASIDIOMYCETES.

By F. T. Brooks, M.A. (Cambridge University).

Most fungi with the exception of those which are obligate parasites like Rusts and Mildews may be grown upon artificial media of one kind or another, choice being usually made of the media most nearly approaching in character those on which the fungi grow in nature. Brefeld, the magician among mycologists who has induced so many of the higher fungi to unfold their secrets, investigated for many years with extraordinary success the life-histories of fungi by the method of pure culture, and those who follow in the path which he has so clearly opened up will always have to refer to his series of brilliant monographs. In his researches, Brefeld used many different kinds of media including decoctions of dung, fruits, potatoes, and meat, among liquid media; and dung, sawdust, bread, as well as gelatine and agar-agar containing various decoctions or mineral substances, among solid media.

Brefeld was not successful in inducing the formation of fruit bodies in the case of some of the higher fungi he cultivated and more recent investigators have obtained greater success in this direction, especially with fungi which live upon woody tissues. Costantin and Matruchot* were the first to grow in pure culture upon blocks of wood one of the higher Basidiomycetes up to the stage of the formation of sporophores. The fungus they worked with was *Collybia velutipes*, and sporophores of normal form though small in size were produced in their cultures on wood of *Robinia Pseudacacia*. Immediately after their success Marshall Ward† cultivated *Stereum hirsutum* in the same manner upon sterilised blocks of Horse-Chestnut wood. The spores were allowed to germinate in agar plates and the young mycelia were transferred to blocks of wood. Since then many other wood-destroying fungi have been cultivated in pure culture to the stage of the formation of fruit bodies. Thus Biffen‡ has again ob-

* Costantin et Matruchot, "Culture d'un Champignon lignicole." Comptes Rendus, Vol. 119, p. 752.

† Ward, H. M. "On the Biology of *Stereum hirsutum*." Phil. Trans. Roy. Soc. 1897.

‡ Biffen, R. H. "On the Biology of *Collybia velutipes*," Journ. Linn. Soc. xxxiv.

tained the formation of sporophores of *Collybia velutipes* in pure culture, and both Miss Wakefield* and I† those of *Stereum purpureum*, Miss Bayliss‡ those of *Polystictus versicolor*, Learn§ in America those of *Pleurotus ostreatus and Pleurotus ulmarius.*

In growing many of these forms upon wood considerable attention has been paid to the manner in which the lignified tissues are attacked by the fungus in pure culture, and in growing *Stereum hirsutum* in this way it was Marshall Ward's primary object to investigate the process of delignification in a detailed manner. It is obvious that such processes can be investigated more critically by this means than by the examination of tissues of trees attacked by fungi in nature. Considerable light has been thrown upon the manner in which fungi destroy woody tissues by the prosecution of this method. Biffen has shown that the mode in which the common fungus *Collybia velutipes* attacks wood is essentially different from that in which *Stereum hirsutum* attacks it. The latter fungus causes delignification of the walls at the beginning of attack, while *Collybia velutipes* normally consumes the cellulose and leaves the lignin behind.

Many other facts of biological interest have been discovered by the cultivation of fungi under artificial conditions. Spore stages which are rarely or never seen in nature have been found to occur in the life-histories of many fungi when grown in culture media. Thus a large number of the higher fungi investigated by Brefeld || produce conidia of various kinds in the early stages of development, e.g., *Peziza vesiculosa* forms conidiophores when grown in culture media and Miss Marryat¶ has shewn that *Pleurotus subpalmatus* when grown upon Elm blocks gives rise to chlamydospores in the vessels of the wood.

It is frequently difficult to obtain the highest spore stage of a fungus when it is grown upon an artificial medium, especially in the case of the higher fungi. Much can sometimes be accomplished in this respect by changing the character or concentration of the medium. Some fungi which are sterile when grown on gelatine media fructify if the substratum consists of agar-agar, some which produce only vegetative mycelium when grown in a highly nutritive medium fructify readily if partly starved. Never-

* Wakefield, E. M. "Die Bedingungen der Fruchtkörperbildung bei Hymenomyceten." Naturw. Zeitsch. f. Forst. und Landwirt. 1909.

† Brooks, F. T. "Silver-leaf Disease." Journal Agric. Science, 1911.

‡ Bayliss, J. S. "On the Biology of *Polystictus versicolor*." Journ. Econ. Biol. 1908.

§ Learn, C. D. "Studies on *Pleurotus ostreatus* and *Pleurotus ulmarius*." Ann. Myc. 1912.

|| Brefeld, O. "Untersuchungen aus der Gesammtgebiete der Mykologie," Heft X. pp. 333-337.

¶ Marryat, D. "Chlamydospore-Formation in the Basidiomycete, *Pleurotus subpalmatus*," *New Phyt.* 1908.

theless until the present time comparatively few Ascomycetes and Basidiomycetes have been cultivated up to the stage of the formation of asci or basidia. Little is yet known as to the conditions which favour the formation of the ascocarps and sporophores of the higher fungi. It is obvious that before fructifications can arise, the vegetative mycelium must have developed sufficient strength to feed them, and it is likely that the failure to obtain formation of sporophores in the case of some Basidiomycetes is primarily due to the fact that the cultures have not been sufficiently large to enable the mycelium to develop the requisite vigour. When sporophores are produced in culture tubes or flasks they frequently lack the form and consistency of fructifications which develop in nature. This may be attributed to the different conditions under which growth takes place in the two cases. In the culture tube the fructifications develop in a still atmosphere which is often saturated with water vapour, whereas fructifications which arise out of doors are subjected to air currents which tend to increase transpiration. Miss Bayliss* has shewn that when *Polystictus versicolor* is grown in culture tubes, only rudimentary sporophores develop, but if, after the mycelium is well established, the tubes are exposed to atmospheric conditions sporophores of normal shape are formed. As the cultures become older, increasing desiccation may be a factor in the development of fruit bodies for it is well known that certain fungi produce under moist conditions only sterile mycelium. Thus *Merulius lacrymans* when growing in an excessively humid atmosphere vegetates in a most luxuriant manner but does not form fructifications. Light is another factor which exercises a great influence on the mode of development of fructifications in certain of the higher fungi, though in some e.g., the Mushroom, fruit bodies develop quite well in complete darkness. Buller† has shewn that the stimulus of light is necessary for the development of the pileus in *Polyporus squamosus* and *Lentinus lepideus* when growing on woody tissues naturally infected by the mycelia of these forms. The same phenomenon can be observed in some of the Basidiomycetes which have been cultivated under critical conditions. Thus in cultures of *Coprinus plicatilis*, Brefeld demonstrated that in the absence of light the rudimentary fructifications do not form a pileus, and in *Coprinus nycthemerus* no trace of sporophores develops in darkness. In *Stereum hirsutum* on the other hand Marshall Ward‡ found that no difference was observable in regard to the formation of rudimentary sporophores between cultures kept in light and those in darkness and the same is true of my cultures of *Stereum pur-*

* Bayliss, Jessie S., loc. cit. p. 20.
† Buller, A. H. R. "Researches on Fungi," 1909.
‡ Ward, H. M., loc. cit.

purcum. We know little of the influence that variations in temperature have on the development of the higher fungi though it is probably well marked in them as in the lower fungi and imperfect forms. In most methods of growing pure cultures the conditions of aeration are poor, though it is not easy to say what influence this exerts on development, especially as it is difficult to separate the influence of desiccation from that of good aeration. Lakon* found that in pure cultures of certain Coprini the formation of sporophores did not take place as long as the atmosphere remained saturated and stagnant, but when a stream of air was passed through the cultures, sporophores developed readily. Brefeld certainly preferred to use substances such as bread and sawdust rather than more compact materials like wood, gelatine, etc., on account of their better aeration.

In several of the higher fungi it has recently been shewn that different strains of one and the same species exist which behave differently when grown under the same cultural conditions, especially as regards their capacity to form the ascal or basidial stage. Miss Wakefield† in her work on *Schizophyllum commune* and *Stereum purpureum* found that forms isolated from one substratum readily gave rise to sporophores in pure culture, whereas others obtained from different situations and treated in the same way failed to develop fruit bodies. Shear‡ in America has proved that the same phenomenon holds good for the Ascomycete, *Glomerella cingulata.* This fungus causes a disease of the leaves and fruits of many plants and forms both conidia and perithecia. A certain number only of isolations from fresh material resulted in the development of perithecia in artificial culture, the others invariably giving only the conidial stage even when conditions of culture were changed in order to try to induce the formation of asci. Thus in this fungus we may speak of one strain which produces in culture the conidial stage only and of another strain which forms both the conidial and perithecial stages. In such cases as the above no morphological differences can be observed in the fungi at the time of being obtained from different sources. Quite recently Harper and Field§ in their work on *Diaporthe Batatatis* which causes a rot of sweet potatoes in the United States have found the existence of the same phenomenon, i.e., one strain or variety of the fungus which readily

* Lakon, G. B. "Die Bedingungen der Fruchtkörperbildung bei *Coprinus*." Ann. Myc. V. 1907.

† Wakefield, E. M. loc. cit.

‡ Shear, C. L. and Wood, Anna K., "Studies of Fungus Parasites belonging to the genus *Glomerella*." U.S. Dept. Agric. Bur. of Plant Industry, Bull, 252.

§ Harper, L. L. and Field, E. C., "A dry rot of Sweet Potatoes caused by *Diaporthe Batatatis*." U.S. Dept. Agric. Bur. of Plant Industry, Bull, 281.

produces perithecia in culture and another giving rise only to pycnidia.

The cultures of fungi which I am about to describe have all been grown upon wood, as this is the substratum upon which these particular forms are found in nature. The mode of establishing the cultures will be briefly described. In the first place small blocks of wood of the kind usually attacked by the fungus in nature are placed in culture tubes, each piece of wood being allowed to rest upon a thick plug of cotton wool saturated with water. It is found preferable to use tubes which have a water reservoir at the bottom so that the cultures do not become dry too rapidly. The ends of the tubes are plugged with cotton wool and then the group of tubes is sterilised in a boiler or autoclave on two or three successive days. It is advisable to avoid the use of very high temperatures in the process of sterilisation as such may have a deleterious influence upon the substances in the wood which subsequently provide food for the fungus. After the preparation and sterilisation of the tubes, care must be taken to obtain in a state of purity the spores of the fungus which it is desired to cultivate. This can generally be done by taking advantage of the method of spore discharge for the particular fungus in question. Thus by suspending the hymenial surfaces of Basidiomycetes over sterilised glass slides under suitable conditions for the formation of spores one usually obtains a good spore deposit; in a similar manner the fructifications of many Ascomycetes may be allowed to project their spores on to sterilised cover slips suspended above the ascocarps. Having obtained the spores in a state of purity they are transferred directly to blocks of wood in culture tubes by means of a sterilised needle or scalpel, care being taken to prevent contamination of the tubes by other organisms at the time of withdrawing the plugs of cotton wool. The inoculated tubes are then placed in a dull light at ordinary temperature and are observed at intervals. Some weeks occasionally pass before the production of an evident mycelium, and more than once tubes have been thrown away because it seemed likely that the fungus was not going to develop although it has subsequently transpired that sufficient time had not been allowed for development to take place. If this method is followed with care, contaminations are of rare occurrence, and in the majority of the fungi I have endeavoured to cultivate in this way there has been no difficulty in establishing good mycelial growths.

The first fungus of which pure cultures will be described is:—

Chlorosplenium aeruginosum (Oed.) de Not.

which is well known as the cause of the greening of various kinds of wood such as Oak, Beech, Ash, Hazel, Alder, and Birch. This

wood is applied to various ornamental uses by turners at Tunbridge Wells and elsewhere, and articles made of it are known as Tunbridge Ware. Fructifications of this fungus were obtained during the foray of this Society at Forres in 1912, and Mr. H. H. Thomas kindly gave me a few ascocarps on returning to Cambridge. These were rather shrivelled at the time but rapidly recovered on being moistened, and, the spores being violently ejected from the asci, it was easy to obtain them in a pure state by suspending sterilised coverslips over the cups. The spores were transferred to blocks of Ash wood upon which a white mycelium began to develop in a few days. Soon after, the mycelium turned a beautiful green colour similar to that of the fructifications, and gradually spread over the wood and into the cotton wool at the bottom of the tube. The mycelium has since been transferred to other tubes in which it is growing vigorously. When the first cultures were established on blocks of Ash wood, spores of the fungus were also placed on Plum wood. On this material only a feeble growth has resulted, and the mycelium after an interval of some months lacks the brilliant colour which is associated with active growth on Ash wood. I do not know of any record of the fungus being found on Plum wood in nature, and this substratum is evidently unsuitable for its development. Green mycelium taken from a culture on Ash wood has been transferred to blocks of Plum wood but it has invariably lost its colour in the course of development on the latter. Green mycelium from a pure culture has been transferred to blocks of Oak wood upon which it has grown well. The same mycelium placed upon Pine wood develops with exceeding slowness but it remains green in colour.

It will be remembered that a controversy raged for many years as to whether greening of wood was due to this fungus or whether the wood could become green apart from its action. The evidence was strongly in favour of the fungus being the sole cause of the greening, but when de Bary wrote his Comparative Morphology and Biology of the Fungi in 1884 the matter was still open to discussion. In 1891 Brefeld,* writing on cultures of mycelium obtained in nutritive solutions from spores, pointed out that of two mycelial growths which he established one was colourless and the other bright green, from which he concluded that the greening of wood was caused by this fungus.

If any doubt still exists as to *Chlorosplenium aeruginosum* being the cause of the greening of wood it can be set at rest by my cultures, for the blocks of Ash wood and Oak wood which have been covered by the mycelium for some months are green

* Brefeld, O. "Untersuchungen aus der Gesammtgebiete der Mykologie." Heft. X.

throughout. Sections shew that the green hyphae of the fungus have penetrated to the centre of the block and are especially abundant in the vessels. The walls of some of the elements of the wood assume a greenish colour but the chief factor in the colouring of the wood is the accumulation of lumps of a green amorphous substance in the different elements especially in the cells of the medullary rays. This substance is probably a bye product caused by the action of the fungus on the tissues. The action of the fungus in pure culture therefore agrees closely with its action on naturally infected wood as described by Prillieux in 1877.† Very little delignification has yet resulted in my pure cultures because the fungus has only acted on the wood for a limited period, but Prillieux has shewn that in nature, when the action of the fungus is prolonged, delignification is effected, and by this the wood loses its value for the purpose of ornamental work. It is well known that the colour of this fungus is stable, and resists the action of many chemical agents. It is insoluble in alcohol and ether although it is acted upon by chloroform. Mineral acids have scarcely any effect upon it but the colour is taken away by alkalis. In my cultures conidia similar to those described by Brefeld have been produced, but no formation of spermogonia as described by Tulasne‡ or of ascocarps has yet taken place.

Daldinia concentrica (Bolt.) Ces. et de Not.

The large black fructifications of this fungus are of frequent occurrence on stumps and branches of Ash trees in this country. At maturity the walls of the asci break down and the spores are extruded in threads from the orifices of the perithecia which stud the surface of the fruit-bodies. Spore discharge continues for weeks and the quantity of spores produced is enormous, large black masses of them accumulating round the fructifications when kept in the laboratory. The mycelium of the fungus grows well on blocks of Ash wood on which spores have been placed. At first white in colour the mycelium becomes tawny with age, and where it comes in contact with the glass tube it aggregates and becomes blackish in colour similar to the hyphae which form the matrix of the stroma. The mycelium in pure culture produces branched conidiophores from which elliptical, hyaline spores, $6\text{-}8 \times 3\text{-}4\mu$ in dimensions, are abstricted; these spores are sometimes grouped together in small heads. Möller,* who investigated in Brazil the biology of this fungus, obtained a similar

† Prillieux, "Sur la coloration en vert du bois mort," Bull de Soc. bot. de France, 1877.

‡ Tulasne, Carpologia, III. Paris, 1865.

* Möller, A. "Phycomyceten und Ascomyceten." In Schimper A.F.W. Bot. Mitth. aus den Tropen Heft 9. Jena, 1901.

conidial stage by sowing the ascospores in nutritive solutions, and in the closely allied *Hypoxylon fuscum,* which Brefeld grew from ascospores, similar conidiophores developed under cultural conditions. A conidial stage of *Daldinia concentrica* which occurs in nature is described in Rabenhorst's Kryptogamen-Flora, and Dr. Bayliss Elliott informed the Society at its meeting at Haslemere that she had recently had this stage under observation. In these cultures the hyphae of *Daldinia concentrica* readily penetrate the wood, being especially abundant in the vessels.

Hydnum coralloides (Scopoli) Fr.

In September 1912 some very fine fructifications of this fungus developed on dead portions of an Ash tree in a private garden in Cambridge. The Ash log on which the fungus grew was only slightly decayed. One of the fructifications was 9 inches in diameter and 4 inches in height and looked exactly like a mass of white coral. Fructifications of *Hydnum coralloides* persist longer than one would be led to believe from their delicate appearance; their form is retained for more than a fortnight and spore discharge continues at least ten days. A fructification was suspended over a clean sheet of glass and the following morning spores deposited on the glass were transferred to tubes containing Ash wood. A thin white mycelium became evident in three weeks and towards the end of December two branched fructifications with well developed spines were formed on the wood in one of the tubes. These fructifications though small, being only an inch high and half an inch broad, were closely similar in structure to those occurring in nature. The following February another culture produced a sporophore but this was less normal in appearance than those already described. Other tubes have since developed fructifications of rather an abnormal type. Subsequent transfers of the mycelium to other blocks of Ash wood resulted in the formation of sporophores which were more abnormal in form than those first produced and upon which spines were developed in a rudimentary manner.

During October 1913 another large fruit body of this fungus developed on an Ash log in the same garden.

Fomes igniarius (Linn.) Fr. var. *pomaceus* (Pers.) Fr.

This fungus is commonly met with in this country on the trunks and branches of Plum trees, Damsons, and Greengages, especially the two latter. It frequently causes the death of limbs of these trees but as its progress is slow it can easily be checked in fruit plantations by cutting away affected parts.

Plum wood affected by the fungus in nature becomes dark brown in colour during the early stages of attack on account of

the accumulation of gum-like substances in the cavities of the cells. For a long time I was unable to obtain a spore deposit from the fruit bodies, but success ultimately was met with and pure cultures were established upon plum wood. The mycelium of this fungus is white in the early stages of development, but as time proceeds dense yellowish brown aggregations appear in certain parts of the tubes and these are doubtless rudimentary sporophores, although spore-bearing surfaces have not yet developed. The mycelium permeates the wood and causes the accumulation therein of gum-like substances as in the case of naturally infected branches. Hartig* has described the action of *Fomes (Polyporus) igniarius* on naturally-infected Oak wood, and though there has yet been little delignification in my cultures the action of the fungus on the elements of the wood appears to be closely similar in kind to that described by him. No conidial stage has been observed in the pure cultures.

Pleurotus ostreatus (Jacq.) Fr.

The oyster shell fungus, as *Pleurotus ostreatus* is popularly called, is frequently seen growing from the trunks and branches of Elm trees in this country, and it is commonly found also in North America where Learn† has recently described its action upon naturally-infected wood of Maple *(Acer saccharum)*. This fungus has been grown in the usual manner on blocks of Elm wood. Its mycelium is white in colour, and in my culture is characterised by an extremely profuse growth. So luxuriant has this growth been that the lower halves of the culture tubes have become completely filled with mycelium.

Fructifications began to appear in each of the culture tubes after about four months and have continued to develop successively. Sometimes the fruit bodies arise in groups, sometimes they are single. The pilei are smaller than those produced in nature and the stalks are relatively longer. Gills are well developed and appear to be normal in structure; they are decurrent as in the fruit bodies which develop in nature. Learn speaks of the production of abnormal sporophores in his cultures of this fungus on bass-wood and oak but he does not say if gill surfaces were formed on them.

Hyphae penetrate the blocks of wood and delignify it in the manner described by Learn for the naturally infected wood.

Coprinus sp.

Two years ago a charred log of wood partially covered with a mycelium belonging to an *Ozonium* was sent to me. The log

* Hartig, R. "Zersetzungserscheinungen des Holzes." Berlin, 1878.
† Learn, C. D. loc. cit.

was placed on the roof of the Botany School, Cambridge, to see whether in the course of time any fructifications would develop in connection with the *Ozonium.* No change occurred for more than a year, although the latter remained constantly present, but during June 1913 fructifications of a *Coprinus* began to develop from the *Ozonium* mycelium. It was easy to demonstrate the connection between the tawny mycelium of *Ozonium* and the young sporophores of the *Coprinus.* The pileus was $\frac{3}{4}$-1 inch in diameter and about the same in height; it was yellowish in colour and covered with small scales when young. The gills were provided with large, colourless cystidia which resembled those of *Coprinus atramentarius* described by Buller.* The stipe was 2-3 inches long and $\frac{1}{8}$ inch in diameter and from the base of it conspicuous yellow strands radiated outwards in all directions. Mr. Carleton Rea tells me the species was probably *Coprinus radians.* Fructifications appeared again on the same log during Novemer 1913. A deposit of spores was obtained in the usual manner and some were transferred to blocks of Elm wood. A white mycelium soon appeared and during the last few weeks the tawny *Ozonium* has begun to develop so that the *Ozonium* has been reconstructed from the spores of *Coprinus* grown in pure culture. This is the first time this has been accomplished as far as I am aware, although the reverse process of tracing the *Ozonium* mycelium into fructifications of a *Coprinus* has been described before. Thus Plowright† stated in the Transactions of this Society published in 1902 that he had traced the connection between *Ozonium auricomum* Link and fructifications of *Coprinus domesticus.*

I hope to continue investigations on the cultures which have been briefly described in this paper.

* Buller, A. H. R. "The cystidia of *Coprinus atramentarius.*" Ann. Bot. 1910.

† Plowright, C. D. "*Ozonium auricomum*, Link." Trans. Brit. Myc. Soc. 1900-1.

RECENT PUBLISHED RESULTS ON THE CYTOLOGY OF FUNGUS REPRODUCTION (1913).

By J. Ramsbottom, M.A., Department of Botany, British Museum.

Possibly in no other branch of botany is such activity being displayed as in the study of fungi. Not only is this activity seen in the case of plant diseases, but also in every other branch of mycology. During the past year much has again been accomplished in the investigations concerning the cytology of fungus reproduction. Certain points have been cleared up, and it becomes more and more apparent that there is much variation to be found even in those groups where many seemed of the opinion that the whole of the phenomena were understood. The new variations constantly met with are probably part of the attraction for workers. The continual confirmation of well-known and stereotyped occurrences would be of interest to few.

Much investigation is being carried out at present on members of the Archimycetes. Kusano (1912) has studied the life history and cytology of a new species of *Olpidium, O. Viciae.* "In the fungi, the copulation of motile isogametes has hitherto received no special attention." Sorokin (1874) described the mycelial vegetative body as derived from the zygospore resulting from the union of zoospores in *Tetrachytrium.* Fisch (1884) observed the formation of the zygote by copulation of zoospores, and its development after infecting the host in *Reesia* and in *Chytridium Mesocarpi.* Griggs (1910) working with *Monochytrium* states that the swarm-spores perforate the cell wall and enter the cells, where they present amoeboid forms within the protoplasm of the host. Some of these fuse in pairs but their nuclei remain distinct. This zygote grows to form a binucleate resting spore. Other swarm-spores grow to form zoosporangia.*

"The planogamete copulation in the lower fungi would afford a subject of the deepest interest. For in establishing this fact, the parallelism of the evolution of sexuality in the fungi and algae, which has hitherto been apparent in so far as the somewhat advanced process of sexuality is concerned, can be justified

* See also the account concerning *Rhodochytrium spilanthidis.* Trans. Brit. Myc. Soc. IV., p. 129 (1913).

farther down to the level of the most primitive and simplest sexual process, and it will thus give a basis to the study of the phylogenetic relationship among the lower fungi themselves, or between them and the algae."

In *O. Viciae* the zoospores are colourless, oval in form when in active motion, and have a long posterior cilium about five times the length of the body. "The swarming period depends largely upon the temperature of the medium. . . . The surviving active zoospores, after continuous swimming movement for shorter or longer periods, stop suddenly upon the substratum; then they undergo an amoeboid deformation, sometimes creeping over the substratum, or they adhere to it with a pseudopodium-like process protruded from the head; and shortly after, attempting to detach from the substratum by a shaking movement, they dart away rapidly as soon as they are freed. Before coming to final rest they repeat this process several times." The zoospore which has come to final rest soon begins to encyst. The body contracts and the cilium appears to be thrown off suddenly. In cover-glass preparations it was quite usual to find zoospores in copulation. The motile zygote thus formed is spherical or elliptical, resembling the zoospore in motion. The zygote behaves in different ways according to the conditions. It may swim for a short time, then become amoeboid and then repeat the swimming movement, or the swimming movements may be entirely omitted. No external difference can be recognised between the copulating zoospores, "but from the fact that any two spores coming into contact are not always induced to fusion, but, after attempting it for a few minutes, may detach again from each other, it appears highly probable that a certain internal differentiation is called forth in becoming the gamete." The author thinks that there is no "attracting action between the zoospores"; also that there is a certain period or age in the zoospore at which copulation is possible. "It will be seen that the sexual action . . . is at an exceedingly primitive state, and in reality a sexual distinction between the gametes is still obscure." After encystation the zoospore and the zygote undergo similar development up to a certain stage, the former later develops into the zoosporangium, the latter into the resting sporangium. The mode of infection of the host plant is of the usual type. A short process is developed from the wall, and this acts as an infection tube and perforates the epidermal wall. Soon after infection the parasite closely approaches the host nucleus, where it commences very rapid growth. No amoeboid or other deformation was ever observed.

The young zoosporangium grows in a spherical form as far as the space in the host admits. Sporangia may vary exceedingly in size (20μ to 120μ). When the fungus is approaching its maxi-

mum growth, a membrane appears on its surface, which, becoming gradually distinct, differentiates into a hyaline sporangial wall. "The short exit tube is single or numerous according to the size of the sporangium." The young sporangium is at first uninucleate, but with growth the nuclei increase in number. While the nuclei are few the cytoplasm is compact. Then a vacuole begins to appear in the centre and increases in size, the nuclei being arranged peripherally. The vacuole afterwards disappears and the cytoplasm is arranged in irregular masses round each nucleus, thus forming an irregular network structure. At this stage the nuclei become larger, and present a distinct structure, a nucleolus, chromatin, and a few linen threads being recognisable within a well defined wall. In certain other Phycomycetes this period is considered to be the stage immediately preceding zoospore formation. In *O. Viciae* "the transition from the single-vacuolate to the network stage does not mark the approach of maturity. Further growth takes place, increasing the amount of the cytoplasm and the number of nuclei, whereby the reticulum becomes finer and finer, diminishing the clear space of the meshes. At the close of the maximal growth, when the last nuclear division is over, by which the nuclei of the zoospores are constructed, the cytoplasm becomes of a quite homogeneously denser state throughout, leaving no apparent vacuoles." This is a similar account to that given by the author for *Synchytrium Puerariae* (1909). "In both fungi the vacuolate stage of the sporangium pertains only to its early stage of development, the mature stage being represented by a dense consistence of the protoplast. During the growing period, or the vegetative phase of the fungus, we observe an increase of the nuclei in size. Entering the period of the zoospore formation, or the reproductive phase, they are reduced in size in successive divisions." At the former period the manner of the nuclear division is somewhat obscure. In no case was the occurrence of a typical mitotic division observed. Kusano writes, "If I understand the figures . . . aright, the division resembles amitosis. Differing from the usual amitosis, there is disappearance of the nuclear membrane and the chromatin as well as linin. It is very likely the 'Promitose' proposed by Naegler in the nuclear division of *Amoeba*. In the latter period the occurrence of the mitotic division is quite certain." The nucleolus disappears during the division but the exact process by which the nuclei divided could not be made out. Thus there can be distinguished "two different modes of the nuclear multiplication, one in the vegetative phase and the other in the reproductive phase, as already known in other Chytridiales and the Plasmodiophoraceae." A satisfactory explanation of zoospore formation is not given "as the minuteness precludes an exact observation." In the mature sporangium the contents appear as a compact

homogeneous mass. No progressive division was observed in the fixed material but a clear space appears suddenly between each two nuclei cutting the protoplasm into as many polygonal parts as there are nuclei.

Among the spherical and naked fungus bodies in the host cells are found certain larger ones. These are binucleate and have arisen from the encysted zygote. They develop into resting sporangia. During the growing period the nuclei remain intact while their size increases gradually. At the first stage they have the simplest structure, only a small nucleolus being prominent. As they grow, the nuclear membrane becomes clearer and the enlarging nucleolus becomes vacuolate and disc-shaped. On the nucleus attaining the maximum size, the linin threads and chromatin granules become conspicuous, assuming a reticulate structure. As the resting sporangium becomes fully grown its centre is occupied by a large vacuole, the two nuclei occupying peripheral positions usually opposite each other. A membrane now appears on the surface of the sporangium. "At this time the nuclei undergo the most remarkable change. The nucleolus which has been attached to the inner side of the nuclear membrane appears now as displaced outside it." A nuclear budding takes place at the tip of the nucleolus immediately following the dislocation of the latter. "This bud gradually increases in size and can attain nearly the form and size of the mother-body, resulting in the formation of a dumb-bell-shaped nucleus with the nucleolus in the median portion." Later the budded portion disintegrates, its wall is broken and the contents are thrown into the central vacuole. "When the sporangium is going to precipitate the inner wall, the dissolution products of the nuclei begin to be distributed from the vacuole in the surrounding cytoplasm, while the vacuole in turn comes to be replaced by the cytoplasm until it disappears finally." The cytoplasm in consequence becomes highly stainable. The sporangium now enters upon the resting period. Just before germination the cytoplasm appears homogeneously granular and hardly stainable. "Among such sporangia we find several stages of the nuclear feature indicative of karyogamy." A few sporangia were found in which only a single larger centrally situated nucleus occurred. Stages of fusion were difficult to observe. The author thinks that the first divisions of the fusion nucleus are karyokinetic and represent reduction divisions. In the multinucleate sporangia it is highly difficult to get a clear idea of the dividing stages of the nuclei as at these stages they exhibit only an obscure outline and give no definite figure.

One of the Archimycetes in which a sexual process has long been known is *Polyphagus Euglenae.* Nowakowski (1876) gave an excellent account of its general structure and life his-

tory as observed in living specimens. Wager (1898) gave a brief account of the structure of the nuclei and their behaviour during the formation of the zygote. Dangeard (1900) confirmed Wager's results in general and added to them. Wager (1913) has again studied the cytology of the fungus. The thallus is unicellular and uninucleate. The pseudopodia or haustoria which radiate from the cell in all directions are prolongations of the cell body and continuous with it. A single cell may attack a large number of *Euglena* individuals, frequently from thirty to fifty. The latter are only attacked by the parasite when they are in a rounded-off and encysted state; so long as they are motile, the haustoria are unable to obtain an entry. The haustorium quickly penetrates the *Euglena* cell by perforating the cell wall. It then branches in all directions and soon brings about a complete disintegration of the cell contents. The protoplasm of the cell is dense and granular, and contains numerous oil drops. The pseudopodia show finely granular contents with minute oil drops. The structure of the resting nucleus differs somewhat from the normal structure in higher plants and recalls what was described by Percival in *Chrysophlyctis endobiotica.* In the centre is a slightly staining, more or less spherical mass connected with the nuclear membrane by delicate radiating threads. All the chromatin of the nucleus is contained in an arc-shaped cap. Reproduction takes place by means of zoospores produced in sporangia, which may be formed as outgrowths on the ordinary vegetative cells, on cysts, or on sexually produced zygotes. The zoospore has a single anterior cilium. At the anterior end, immediately beneath the point of attachment of the single cilium, is a yellow or orange-coloured oil-drop. The nucleus and the oil globule are in close contact with one another and are surrounded by a deeply stainable chromidial mass which appears to be continuous with the cilium just at the point where it is given off from the zoospore. Immediately the zoospores come to rest they round themselves off and begin to germinate. In the early stages of the growth of the young thallus, the chromidial mass persists around the nucleus and appears to be directly connected with the pseudopodia. The cysts are spherical cells each with a single nucleus surrounded by chromidia. "The zygote is formed by the fusion of two ordinary vegetative cells, which, instead of producing zoosporangia, become transformed into gametes. The gametes are usually different in size, the smaller one functioning as the male, the larger one as the female." The male gamete puts out a delicate pseudopodium-like process which comes in contact with the female gamete. "Whether there is any definite attraction between the two gametes, or whether it is merely a chance encounter, I have not been able to determine. The copulating pseudopodia do not differ in any respect, except

possibly that of extreme length in some cases and absence of branching, from the ordinary haustoria." The zygote is produced by the swelling of the apex of the pseudopodium near its point of contact with the female cell. The protoplasmic contents of the male cell immediately pass through the delicate pseudopodium into the zygote. A perforation appears in the wall between the young zygote and the female cell, and the contents of the latter pass through it into the zygote which is then cut off by partition walls from the remains of the two gametes. "The nuclei of the fusing gametes have exactly the same structure as those of the ordinary vegetative cells. The male nucleus is, however, usually smaller than the female, and contains less chromatin." Apparently owing to conditions of food supply the zygote may have either a spiny or a smooth wall; the former case seems to be the normal one. Nowakowski stated that the smooth walled zygote was formed as an outgrowth from the female cell just where it comes into contact with the male pseudopodium, but neither Dangeard nor Wager found any example of this second method of zygote formation. Dangeard, however, in describing the formation of this type of zygote, states that the female nucleus ordinarily passes in first, then the male, but in all the cases he has observed Wager finds that the male nucleus is the first to enter the zygote. In the zygote the two sexual nuclei come into contact with each other. The smaller nucleus then increases in size, probably at the expense of food material in the zygote, and this continues until it is almost exactly similar in size to the female nucleus. The two nuclei then move apart to opposite sides of the cell. When the zygote is first formed it frequently contains a number of deeply staining granules scattered throughout its cytoplasm which are probably the remains of the dense granular masses derived from the gametes at the time of fusion (Dangeard's "coenospheres"). As the zygote develops they gradually disappear, and at the same time the oily contents of the cytoplasm increase in quantity to form a supply of reserve food material for use at a later stage. "The two nuclei then undergo considerable changes. Chromatin material in the form of amorphous masses or granules is extruded from them into the cytoplasm, and they become smaller and lose to some extent their capacity for stains. These granules become massed into two more or less distinct groups, one being produced by each nucleus. Shortly after their appearance they fuse together into a single dense mass in the centre of the zygote. The author proposes the term 'chromidiosphere' (or 'chromidiocentrum') for this mass. The two nuclei remain visible through all the subsequent stages of development either at the periphery of the chromidial mass or slightly embedded in it. The sporangia formed when the zygotes germinate vary very considerably in

size and in the number of zoospores produced. Preparatory to germination the chromidial mass in the zygote loses to some extent its capacity for stains. On germination, whatever is left of it passes with the two nuclei into the sporangium and there becomes disseminated through the cytoplasm. "The two nuclei, which now stain more deeply but are still very small and quite unlike the primary nucleus of the asexual sporangium, come into close contact with one another and apparently fuse. The exact process of fusion has not been observed, and it is quite impossible to say whether the chromosomes fuse together or become merely intermingled, to separate later into two groups. The structure of the nuclei at the fusion stage has not been clearly ascertained, but there are indications that previous to fusion the chromatin mass breaks up into granules, probably chromosomes. The subsequent stages of nuclear division in the sexual sporangium seem to follow the same order as in the asexual sporangium." Nuclear division takes place only in the sporangia, never in the vegetative cells, gametes, or zygotes. The single large nucleus which enters the asexual sporangium from the vegetative cell at once divides into two, then four, etc., until sometimes several hundreds may be formed. The process of division of the primary nucleus of the sporangium was not observed, "but in all the later stages it is mitotic, and is probably the same, therefore, in the primary nucleus." The spindle is internal and is apparently formed out of the lightly stained chromatin mass which is found in the middle of the nucleus in contact with the chromatin cap. "The chromosomes are about ten or twelve in number and very minute. Only a very small portion of the large and dense chromatin mass is used up in their formation; the rest forms a thick peripheral layer on the wall of the nucleus, which is visible during all the stages in the prophases of division, and is finally set free in the cytoplasm to be used up in the further growth of the sporangium." The nuclear wall breaks down first at the poles, where kinoplasmic substance with radiating striae appears. The chromosomes become aggregated at the periphery of the newly constructed daughter nuclei, in close contact with a lightly staining substance, consisting of a very fine network which almost completely fills up the rest of the nuclei. A few delicate strands remain for a short time between the daughter nuclei but these soon disappear and the nuclei are left free in the cytoplasm. When the nuclear divisions are completed the cytoplasm begins to segregate around the separate nuclei to form the zoospores. Irregular splits appear throughout the whole of the sporangium by means of which uninucleate masses are soon divided off. A condensation of fine granular deeply stainable substance begins to aggregate around the nucleus and its attendant oil globule. The spore origins then apparently fuse, but soon after fine lines of de-

marcation again appear and delicate cell-walls form around each spore. This interesting account shows great points of resemblance with regard to the cytology of the zygote to that of Kusano for *Olpidium Viciae.* There are also obvious relations with *Zygorhizidium Willei* where Loewenthal (1905) reports that two uninucleate gametes fuse by means of a copulating tube put out from the smaller male cell, the contents of which pass over through it into the larger female cell, which thus becomes the zygote. According to the author "*Polyphagus* shows relationships with various other genera of the Chytridiaceae, leading on the one hand to the Oomycetes and on the other to the Mucoriaceae. In its general structure and in the formation of chromidia it also shows connexion with the Protozoa. In *Polyphagus* we can clearly see the dual nature of the nucleus in that the larger part of the chromatin contained in it is definitely extruded for purposes of metabolism, only a small part being left for nuclear division and reproduction. The double fusion in *Polyphagus,* consisting of a chromidial fusion in the zygote followed by nuclear fusion in the sporangium, may afford some clue to the explanation of the delayed nuclear fusions and double nuclear fusions observed in the higher Fungi."

Němec (1912) has studied the development of *Olpidium Brassicae.* Faworsky (1910) had previously worked at this fungus, and Němec confirms, and adds to, his results. The youngest stages observed were naked spherical bodies with non-vacuolate, granular protoplasm. As the parasite grows its protoplasm becomes vacuolate, but its nucleus retains its central position, and as it becomes larger, shows a finely granular or fibrous structure and a large spindle-shaped nucleolus which lies against the nuclear membrane. The parasite grows considerably before nuclear division commences. The contents of the large nucleus become thread-like and a paired arrangement of the threads is often seen. The constantly excentric position of the nucleus in the spherical cell is now rather striking. The author did not succeed in seeing the first nuclear division. The binucleate parasites have a vacuolate cytoplasm; the nuclei usually lie almost in contact and each contains a large peripheral nucleolus. The author was also unsuccessful in observing the second division, although he observed a binucleate parasite where each nucleus possessed two nucleoli suggesting that the nucleoli persist during nuclear division. Stages with four nuclei were common; the nuclei are regularly dispersed in the cell and the cytoplasm contains large vacuoles and deeply staining granules. The nucleoli are still large and lie against the nuclear membrane. Further nuclear divisions occur so that from eight to as many as sixty-four nuclei can arise. The number of divisions probably depends upon the nourishment and the growth of the cell, as para-

sites of very different sizes can proceed to zoospore formation. Before the latter occurs the structure of the cell alters—the vacuoles disappear and the cytoplasm becomes finely granular, the nuclei are reduced in size almost to a point, and the nuclear contents become coarsely granulate. The parasite now surrounds itself with a clear membrane and forms an exit tube, which, at its origin, is filled with dense cytoplasm. Nuclei enter this and probably divide once or twice. All the nuclear figures found occur at the same stage; the spindle is very weakly developed and the chromosomes could not be counted. During division, the nucleolus disappears. The cytoplasm now breaks up into uninucleate zoospores, by the segmentation of the protoplasm from the periphery inwards and by the formation of interior vacuoles. The zoospores are round with a peripheral nucleus containing a small nucleolus lying on the nuclear membrane.

Most of the cysts observed were uninucleate, but in a few cases multinucleate cysts were found which were obviously preparing for zoospore formation. It is exceedingly probable in the light of recent investigations that the cysts arise from fused zoospores as in *O. Viciae.*

Němec also worked with two new species of *Entophlyctis*, but chiefly from a morphological standpoint. The young zoosporangia of *E. Brassicae* are pear-shaped and attached to the cell wall of the host plant by the broad end. They are uninucleate and their protoplasm is dense and sometimes contains deeply staining masses. There is a clear, mostly central nucleolus. The parasite remains uninucleate until it has reached a certain definite size, when it begins to multiply its nuclei and form zoospores. The characteristic resting spores are also formed. These at maturity are uninucleate and have a dense cytoplasm containing deeply staining masses. The vegetative stage of *E. Salicorniae* is also uninucleate and later becomes transformed to a zoosporangium or a resting spore.

It would seem from recent studies that the longstanding problems of cytology and reproduction in the Archimycetes will be cleared up in the immediate future. It is certain that there is in some cases a copulation of zoospores, a phenomenon, the presence or absence of which, has long been debated.

In the Phycomycetes, Barrett (1912) has studied the development of a species of *Blastocladia (B. strangulata* n.sp.*)* a genus of doubtful affinities. The plant is attached to the substratum by a system of rhizoids and has a basal cell which passes above into a dichotomously branched or umbellate system of which the final branches terminate in one or more reproductive bodies. At the points of origin of the branches constrictions are present suggesting that the genus belongs to the Leptomitaceae. Peculiar perforated pseudo-septa are formed at the constrictions and are

in a way comparable with the "cellulin" rings of *Gonapodya* and other Leptomitaceae though they are much more highly developed. In young, actively growing plants the protoplasm is much vacuolated, granular, and contains, distributed throughout it, prominent nuclei having deeply staining bodies. Also there are present other deeply staining bodies which are more or less regular in form and of various sizes. Their true nature was not determined. Always present in more or less abundance, their extent of occurrence depends, to a degree at least, on growth conditions. Bodies somewhat similar in appearance are known to occur in the hyphae of members of the Saprolegniaceae. "Under the best normal conditions for growth, the production of zoosporangia precedes that of resting sporangia. In pure culture this order is easily reversed by properly manipulating external conditions. . . . The extent to which branching may proceed before the production of reproductive organs varies greatly." The zoosporangia may originate terminally or subterminally on the branchlets and may be produced singly or in chains. Before reaching its normal size, the zoosporangium becomes cut off from the hyphae by a septum, and papillae of dehiscence begin to appear. The protoplasm is granular, vacuolate and contains, distributed throughout it, prominent nuclei and the deeply staining bodies above referred to. The number of nuclei is at first small, "and there is apparently no marked passage of the nuclei from the adjacent portions of the mycelium such as occurs in the developing sporangia and sexual organs of many other Phycomycetes." The nuclei in the upper half of the sporangium are in various stages of division. As growth proceeds the nuclei rapidly increase in number until there are about sixty present. About the time the zoosporangium reaches its full size the nuclei arrange themselves peripherally. From the frequency of this stage it seems as if the zoosporangium now rests. Next the large nuclei become distributed throughout the more coarsely granular protoplasm. The number and size of the deeply staining bodies increases, and some of them show a vacuolate condition. The nuclei associate themselves with the deeply staining masses and in a number of cases become more or less imbedded in them. Segmentation now "proceeds from the periphery inward in a more or less radial direction much as described by Harper for *Synchytrium decipiens*. The lines of division are first recognised as rows of granules, at first more or less indefinite, but which become more and more apparent until they seem entirely to outline the spore mass." Apparently contraction now takes place. The nuclei with their associated material assume a more regular form. The nucleus itself is drawn out to a point which in some cases extends to the very limits of the spore and "strongly suggests that the cilia have their origin through its

direct influence." Segmentation usually results in the formation of uninucleate zoospores though occasionally binucleate ones are found. The cilia are posterior and their number varies from one to three though the uniciliate condition is much the most frequent. In preparation for germination the zoospore comes to rest and gradually absorbs its cilium. The large reserve food body disappears and a large number of variously sized granules take its place. The body of the zoospore forms the basal cell of the plant, the germ tube forming the basis for the subsequently developed rhizoid system. As the germ tube elongates the nucleus increases in size and finally divides. The resting sporangia develop in the same manner as the zoosporangia and in their younger stages cannot be distinguished from them. The wall, however, later thickens and there are no papillae. When mature they contain a number of oil globules. In the young stages the protoplasm has much the same appearance as that of the young sporangia. Later the nuclei become arranged peripherally and the central mass of granular protoplasm contains several reserve food bodies and is surrounded by prominent vacuoles. In the mature sporangia the protoplasm forms a definite, regularly arranged network in which the nuclei are distributed. Deeply staining masses, more or less irregular in shape, "which probably represent the fusion of several reserve food bodies" are frequent. On germination the contents escape in the form of zoospores not unlike those formed in the zoosporangia. It seems that the resting sporangia pass through a period of rest before germination.

"The resting nuclei are usually spherical in form and contain a large deeply staining body which I assume to be a chromatic nucleolus. Surrounding this body is a fine granular cytoplasm which can be seen forming an irregular network. They vary in size from very small, almost invisible dots to those with a diameter of from 6-7μ. The smaller are found in the actively growing parts where nuclear division more commonly takes place. The mode of division is rather unusual and suggests a form of amitosis. The first indication of such a nuclear division is a change of the chromatin mass from the more or less spherical to an elongated form. A transverse line of division is next seen. The two parts then round up, separate, and appear as two large nucleoli. A wall is finally laid down between the daughter chromatin masses, and the two nuclei result." In dividing nuclei there is a faintly staining homogeneous substance connecting the separating chromatin masses, which suggests some sort of a spindle. "Two explanations suggest themselves: (1) That we are dealing with direct nuclear division and that the faintly staining substance is the cytoplasm contracted about the dividing chromatin masses; and (2) that division is indirect and that the

large chromatin mass represents a single chromosome." It seems unusual, if not improbable, that such a highly differentiated plant in so many respects should possess only a direct method of nuclear division. Barrett suggests that the fact that no sexual organs are known in the genus may have some bearing on the question. He records that Humphreys found a very similar nuclear division to take place in the hyphae of *Achlya apiculata.* He thinks however that there is here a "peculiar type of mitotic division" and contemplates a further study of the question.

Moreau (1913) has published a full account of his studies on the Mucorineae. He firsts considers the asexual reproduction and divides the group into (1) those with sporangia, (2) those with conidiophores, and (3) those with doubtful conidia. The sporangia of the Mucorineae have always been a favourite object for study. Harper (1899) was the first to give clear ideas concerning the cytology of these organs. He described two different processes. In both cases the ripe spores are plurinucleate and result from the segmentation of the protoplasm of the sporangium, but in *Sporodinia* the segments are plurinucleate from their origin whereas in *Pilobolus* they are at first uninucleate (protospores). Moreau finds that in *Circinella conica* the protoplasm which fills the young sporangium is irregularly vacuolate, and contains small nucleolated nuclei. Later the protoplasm becomes vacuolate, particularly towards the centre of the sporangium which is sometimes occupied by a large vacuole. The external portion furnishes the spores; the internal portion remains sterile and becomes the columella. The vacuoles become irregular and separate fragments of protoplasm which, after the formation of a membrane, become spores. "Leur séparation donne l'impression d'une rétraction du protoplasme dont les divers fragments restent quelque temps reliés les uns aux autres par des trabécules." The spore usually forms round a single nucleus, rarely around two. The nucleus immediately divides and the spore becomes plurinucleate (cf. *Pilobolus).* The results obtained in *Rhizopus nigricans* practically agree with those of Swingle (1903). The young sporangium first contains dense protoplasm with numerous nuclei save in a fairly thin superficial layer. Later, this nucleate portion segregates into an outer zone with a few vacuoles and with nuclei having the structure of the ordinary nuclei in the thallus, and an internal vacuolate region where most of the nuclei have no distinguishable nuclear membrane nor nucleolus. The former of these becomes the spore producing region, the latter the sterile columella. "De très belles figures d'amitoses nombreuses ont été observées dans la columelle de *Rhizopus nigricans.*" Some of the nuclei retaining the ordinary structure, and usually situated near the periphery, fuse in pairs and show all the well-

marked features of karyogamy but "l'indépendance de ces fusions et de la sexualité est hors de doute." This phenomenon was also observed in *Circinella conica* and other species. The protoplasm in the sporiferous layer segments into plurinucleate portions which become the spores. Intrasporal substance arises after their formation and appears to be exuded from the spores. The spore formation in *Phycomyces nitens* resembles that in *Rhizopus nigricans* as Swingle also observed. Mitosis was observed in the young sporangium similar in all respects to that recorded by Moreau in the mycelium of several species:—a typical mitosis with a spindle, two centrosomes and two chromosomes.* This points to the absence of any reduction division previous to spore formation. The spores are, at their formation, multinucleate. In *Mucor spinescens* the peripheral portion of the young sporangium at first contains dense protoplasm and numerous nuclei. Later, the protoplasm becomes vacuolate, and by the junction of the vacuoles the protoplasm becomes arranged in cords with the nuclei along them. The cords then become contracted round one or two nuclei and later nip out spores containing usually a single nucleus. This method of spore formation also possibly occurs in *Absidia glauca*. In this species the spores are small and uninucleate. In *A. septata* the spores are of variable size; the smaller ones are uninucleate, and the larger ones contain two or three nuclei. In *Zygorhynchus Moelleri* uninucleate spores are the rule; exceptionally the larger ones can contain two or three nuclei. No differentiation into a fertile and a sterile region could be distinguished in *Mortierella isabellina*. The small spores are generally uninucleate.

In *Cunninghamella echinulata* and *C. Bertholletiae* the swelling which supports the conidia arises as does the sporangium in e.g., *Rhizopus*. The protoplasm separates into two layers, the exterior layer with denser protoplasm and more numerous nuclei. Around the swelling arise small buds attached to it by narrow sterigmata. Each bud becomes a conidium. The nuclei of the periphery pass through the sterigmata into the conidia, and each of the latter contains at maturity from three to eight nuclei. "Au lieu de constituer des spores à l'intérieur de la tête renflée, le protoplasma et les noyaux forment des conidies à la périphérie."

Much discussion has taken place as to whether *Piptocephalis*, *Syncephalis* and *Syncephalastrum* (Cephalideae) should be regarded as having conidia or sporangia. Moreau studied *Syncephalastrum cinereum* and *S. racemosum*. The sporiferous head arises as in the previous case and similarly puts out buds on the exterior. The nuclei elongate and pass into the

* *Cf.* Trans. Brit. Mycol. Soc. IV., p. 133 (1913).

buds, sometimes to the number of twenty. When the elongated buds have reached their full size the protoplasm condenses into spherical or elliptical, usually uninucleate spores, practically simultaneously. Each of the spores surrounds itself with a membrane independent of the tube which contains them. The formation of spores "doit être décrite comme une production de spores internes à l'intérieur d'une sorte de sporange allongé . . . le sac qui les produit n'est pas non plus un véritable sporange homologue de celui des *Mucor*."

The results of the study of zygospore formation in twelve species is given. *Mucor genevensis* (heterogamous, heterothallic), *Absidia spinosa* (heterogamous, homothallic). *Rhizopus nigricans* and *Phycomyces nitens* (isogamous, heterothallic) are the species not mentioned in the previous review.* The account for *M. genevensis* agrees with that given for *M. hiemalis*; and that of *Absidia spinosa* with that of *A. Orchidis*. *Phycomyces nitens* is, like *Sporodinia grandis*, unfavourable for study. Multiple fusions were however clearly observed in the zygote. The account given for *Rhizopus nigricans* is totally different from that of McCormick.† No centrosome is present. Most of the nuclei arrange themselves in pairs, a few degenerate. Moreau's account is consistent. The zygospore in all cases results from the fusion of two multinucleate gametangia. Mitotic divisions of the same type as those in the mycelium occur in the young zygospore. The nuclei then either fuse in pairs or degenerate. In all cases studied, except in *Zygorhynchus Dangeardi*, fusion preponderates and degeneration is rare. The author assumes that the reduction division takes place at the germination of the zygote. The next publications on the nuclear occurrences in the zygospores of the Mucorineae will be received with interest. Moreau's account appears very straightforward after the strangely different results obtained by other workers.

In the Discomycetes Fraser (1913) has investigated the development of the ascocarp in *Lachnea cretea*.‡ "Unfortunately, the nuclei of this fungus are small, and cytological detail did not prove available. The archicarp, however, differs so much from that known in other members of the Pezizaceae that some account of its morphological characters seems to be desirable." The mycelial hyphae vary much in thickness and branch freely, often in a dichotomous manner. In some cases they are frequently septate, in others, especially in the rooting hyphae, the

* The *Mucor* sp. (Trans. Brit. Mycol. Soc. IV. p. 133 (1913)) is now identified as *M. silvaticus*. The two unnamed *Zygorhynchus* spp. have since been described by the author as new species, the one with only four functional nuclei being called *Z. Dangeardi*, the other *Z. Bernardi*.

† *Cf.* Trans. Brit. Mycol. Soc. IV., p. 136 (1913).

‡ Cf. *Lachnea scutellata* (Trans. Brit. Mycol. Soc. III., p. 357 (1912)).

septa are far apart. This difference in septation is a frequent phenomenon in cultures of Ascomycetes and often, under certain conditions an "oidial" condition occurs, e.g., *Ascobolus*, *Ascophanus*, *Pyronema*. The so-called metachromatic granules, commonly present in Discomycetes, occur on the cross walls. The cells contain a network of finely granular cytoplasm and are multinucleate. Usually the archicarp is produced on one of the larger filaments. It forms two or three close coils and undergoes septation. At this time the hypha which bears the archicarp, and others in the immediate neighbourhood, give rise to numerous stout, curved branches which, as usual, grow up and invest the archicarp and the hypha bearing it, till a more or less spherical mass is produced. In the meantime the archicarp has undergone further development. It grows out beyond the coiled portion as a long, sinuous, multicellular filament, passes through the cells of the sheath and ultimately protrudes far beyond them. "At first, all the cells of the archicarp contain scattered nuclei similar to those of the vegetative hyphae; a little later the nuclei in the central and terminal cells have become more numerous, and still later three regions are clearly differentiated. The cells of the stalk differ little from those of the vegetative mycelium. The coiled central region is made up of three or four cells; these enlarge and their nuclei increase both in size and number." The terminal portion constitutes the trichogyne and consists of some eight or nine cells. It becomes more or less emptied of contents and a peculiar change takes place in the character of the transverse septa. They show a large, clear, central area resembling in appearance the callus pad of a sieve tube. In a few cases it was possible to make out that the callus pad is preceded by the formation of an open pore and that a mass of granular substance is continuous from one side of the wall to the other. This stage probably represents a temporary condition. "The terminal portion of the archicarp has been traced in its older stages, outside the young fruit. . . . Frequently it is found to branch near its apex, characteristic septa being found beyond the point of branching. In no case were the apices fused with any other hypha, but whenever the filament could be traced to its termination, the ends were quite free. . . . It is not out of the question that the contents of the trichogyne may empty themselves into the central part of the archicarp, and that in this way a form of pseudapogamy may replace fertilization." In the central portion of the archicarp, the septa between the cells break down, so that a very wide passage is formed and nuclei pass from cell to cell. All the cells give rise to ascogenous hyphae. "In this region of the archicarp the nuclei are crowded together, and here, no doubt, they unite in pairs. But they are too small to yield

really satisfactory data on this critical point, and any attempt to study their behaviour was abandoned. In the part of the ascogenous hyphae nearest the ascogonial cells the nuclei lie irregularly; in the upper parts they are arranged in a single file; sometimes two sometimes three lie close together; sometimes a single nucleus is separated from the others. There is no evidence either when the ascogenous hyphae are first formed, or, at a later stage, of an arrangement in regular pairs." At the base of the group of paraphyses the ascogenous hyphae give rise to the asci in the usual way, by the bending over of the hypha and the growth of its penultimate cell. The first division in the ascus is fairly clear and shows about eight chromosomes but the following divisions were not studied because of their small size.

"Possibly the most useful piece of information derived from the study of *Lachnea cretea* is the fact that the septa of the trichogyne break down. Pores amply large for the passage of male nuclei are formed and thus the multicellular character of this organ no longer appears to impose a barrier in the way of normal fertilization."

In the yeasts (Saccharomycetes) we have two principal types of sexuality; one, (e.g., in *Schizosaccharomyces*) where copulation precedes ascus formation and the other (e.g., in *Saccharomycodes Ludwigii*) where the sexual process is effected between the ascospores themselves. Guilliermond, one of the best known workers at the group, has published (1913) some new observations on their sexuality. Until recently true heterogamy was here unknown. In *Zygosaccharomyces Chevalieri* a certain number of asci appear to arise without the intervention of any sexual phenomena, but most result from a heterogamic copulation. "Les deux gamètes sont des cellules qui n'ont pas le même degré de développement et présentent par conséquent des dimensions sensiblement differentes. La gamète mâle ou microgamète est une cellule très jeune, généralement un bourgeon venant de se détacher de sa cellule mère, il est donc de très petite taille. Au contraire, le gamète femelle ou macrogamète est une cellule adulte, de grande dimension." Sometimes, however, the distinction is not so clearly marked. The male gamete shows dense cytoplasm with a homogeneous nucleus and a small vacuole with metachromatic corpuscles, whereas the cytoplasm of the female is reticulate enclosing basophilous grains while the vacuoles contain metachromatic corpuscles. The nucleus is spherical but its structure is difficult to make out. As the cells separate during budding it is hard to establish whether the gametes are closely related as in other yeasts. The two gametes unite by means of a copulating tube as is usual in other cases. The two nuclei pass into the tube and fuse to form a nucleus, which

at first occupies practically the length of the canal. Then it passes over into the female cell, together with all the cytoplasm from the male gamete and rounds itself off. The egg thus produced appears to form a wall separating it off from the copulation tube. It then soon becomes an ascus with from one to four spores. Under certain conditions swollen spores can fuse with other spores or with vegetative cells and form asci, or can transform themselves into asci without previous copulation. The yeast of Pearce and Barker *(Zygosaccharomyces G)* is regarded as having a sexual process intermediate between that above described and the ordinary case. In this yeast the two gametes are morphologically similar, but the contents of the one, regarded as male, pass over into the other, which gives rise to the two ascospores.

Guilliermond also studied *Debaryomyces globosus*. Placed under conditions favourable for sporulation the cells multiply vegetatively for a couple of days, then sporulation begins. The cells are grouped in small colonies of a variable number of individuals derived from the same mother cell. A certain number of cells then undergo isogamous copulation, "Celle ci s'effectue généralement entre les cellules adultes et de même dimension appartenant à une même colonie de cellules. Elle s'opère donc entre deux cellules identiques et parfois très proches parentes." The gametes have the usual structure. The nuclear fusion generally occurs in the narrow copulation canal into which the gamete nuclei with part of the cytoplasm pass. Two cases then occur according as to whether one or two spores are to be formed in the ascus. In the first case the fusion nucleus divides in a manner not made out and a nucleus passes into each of the swellings of the zygospore, cytoplasm condenses round each, and two spores are formed. In the second case (which resembles an intermediate condition between isogamy and heterogamy but is apparently dependent upon reserve food material) the fusion nucleus passes into one of the swellings with the greater part of the cytoplasm of the two cells and there forms a spore. Only about 25 per cent. of the asci, however, arise as a result of a sexual process. Some arise parthenogenetically. In this case ordinary vegetative cells may sporulate or more often "des cellules pourvues d'une sorte de diverticule et qui ont par conséquent cherché à copuler sans y parvenir." These cells are sometimes isolated and sometimes united by a copulation tube the wall of which, however, is not dissolved. By far the most frequent origin of the asci is one where they arise by a peculiar abnormality. The adult cell gives rise to one or several buds which remain attached to its membrane. These buds are very small but contain a nucleus. The mother cell soon puts out a small beak which attaches itself to the side of one of these buds and the two cells thus become

joined. The wall dissolves and all the contents of the bud pass into the mother cell. There nuclear fusion and spore formation takes place. As the author found that copulation effects itself with difficulty in hanging drop preparations he is rather of the opinion that this is a heterogamous species that is becoming isogamous.

Two other interesting forms were also studied, *Schwanniomyces occidentalis* and *Torulaspora Rosei*. In the former under certain conditions, there is fairly active budding followed by sporulation. Then the cells cease to bud and a large number form projections as if they were about to copulate. They, however, never fuse and in most cases do not even unite in pairs. The single nucleus is generally in the neighbourhood of the tube. It is always placed near a fairly large refringent globule. Usually a single spore is formed around the two, the fat globule occupying the centre, the nucleus being against the cell wall. The first crop of asci is soon followed by another. Most of the cells which have not sporulated form a projection, but only a certain number of these produce spores, the rest degenerate. At the end of a fortnight most of the cells have formed projections, mostly elongated and similar to germinating tubes. They can sometimes join but never fuse.

Torulaspora Rosei shows similar rudiments of an ancestral sexuality. Few spores are formed, and apparently sporulation retrogradation goes hand in hand with that of sexuality. In a medium favourable to sporulation most of the cells seek to anastomose. The attraction is, however, very weak, and the long tubes can often twist round one another without fusing. In no case is there a breaking down of the wall and a mixing of the cell contents. The nucleus of the cell is small and homogeneous. It is highly stainable and its structure is difficult to make out. It is almost always situated near the tube, together with one to several fat globules. The spores generally form in the body of the cell but can arise in any region of the projecting tube. They are one to four in number. When the tube grows to a great length the nucleus can divide to give two daughter nuclei.

Moreau (1913) has studied *Aspergillus (Eurotium) repens*. Dale (1909) investigated this species and recorded two nuclear fusions, one in the ascogonium and one in the young ascus. Fraser and Chambers (1907) worked at *Eurotium herbariorum*, as also did Dangeard in the same year, and, although the former workers thought it probable that two nuclear fusions occurred they were successful in observing only the fusion previous to ascospore formation. Moreau's results are as follows:—The ascogonium is a spiral, multinucleate hypha. A second hypha sometimes occurs which is an effete antheridium ("trophogone") and,

when it occurs, it is the earliest of the enveloping hyphae. The ascogonium fragments into segments containing a variable number of nuclei, "Nous n'avons recontré aucune fusion de noyaux à ce stade." A further segmentation of the ascogonium takes place which gives rise to binucleate portions. At the same time the ascogonium branches in such a way as to fill the cavity of the perithecium with contorted, ramifying, entangled hyphae with binucleate cells. The two nuclei in each cell fuse. The resulting nucleus divides three times and eight uninucleate spores are formed. "Une autre espèce d' *Aspergillus* encore indéterminée nous a fourni les même résultats." The above description agrees with that given by Dangeard for *Eurotium herbariorum.* It differs from that of Dale (and of Fraser and Chambers) in that no ascogenous hyphae are described as arising from the ascogonium; also in the absence of nuclear fusions in the ascogonium. The presence of ascogenous hyphae rather than of a ramifying ascogonium seems more in accord with what one would expect. It is interesting to note that whereas in *A. herbariorum* the ascogonium can be regarded as consisting of a terminal unicellular trichogyne, a unicellular ascogonium and a multicellular stalk no such differentiation is met with in *A. repens.*

Brown (1913) has studied the development of *Xylaria.* De Bary (1864) first indicated the presence of Woronin hyphae in *X. polymorpha.* Fisch (1882) confirmed this and worked out the development more completely in *X. polymorpha* and *X. hypoxylon.* Brefeld (1881) states that thick utricles are present at the beginning of perithecial development in species of *Xylaria.* For the present study *Xylaria tentaculata* was used in the main but also *X. trachelina* and a third species of *Xylaria.* Several attempts were made to germinate the conidia and ascospores but without success—a surprising fact considering the ease with which these can be induced to germinate in *X. hypoxylon.* In *X. tentaculata* the portion of the stroma that first appears above ground is in the form of a cylindrical clavate head. A crease appears at the apex and two lobes begin to grow out. These in turn become lobed at the top. This dividing and lobing continues until there are from nine to fifteen branches formed. They are cylindrical, tapering gradually to a blunt top and covered with a white powder consisting of numerous conidia. After the conidia are shed the branches darken, shrink, and finally fall leaving a short stub. The conidiophores arise as lateral buds of vegetative hyphae a short distance from the growing apex of a branch. They lengthen, some branch, and one or more conidia are formed on the end of each branch. Each conidium contains one nucleus, but more than one was frequently observed in the tip of a conidiophore. The stroma, which was at first of equal

width, now becomes wider at the top. The surface of this knob becomes covered with swellings due to enlargement of the perithecia. Conidia are formed a few millimetres below the branches, but later the entire conidial bearing layer, consisting of the conidiophores and a few layers of cells beneath, is shed. A section of the stalk shows an inner portion formed of white hyphae and an outer portion of hyphae with thick brown walls. The inner hyphae are more or less parallel and extend in the longitudinal axis of the stalk. There are numerous septa. Each cell contains a considerable quantity of cytoplasm and apparently a number of nuclei. "But the number of nuclei in vegetative cells was difficult to determine on account of their being very small and there being also numerous granules in the cytoplasm that stained like nuclei. . . . Small plugs of densely staining material passing from one cell to another through the transverse wall were to be seen in many cases. Similar structures were seen connecting segments of the Woronin hyphae in some few cases," and are compared with what Cutting (1909) described in *Ascophanus carneus*. About the time the conidia are being produced most profusely and before the end of the stalk has increased perceptibly, there appears, a few layers of cells beneath the surface, a small mass of tissue made up of hyphae smaller than those of the main mass of tissue and much more tangled. In the centre of the tangled mass can be seen one or more hyphae made up of much shorter and thicker cells rich in protoplasm. This is the beginning of the so-called Woronin hypha. "Earlier stages of perithecial development could not be identified because of the resemblance of the hyphae to ordinary vegetative hyphae." The cells of the Woronin hypha next lengthen, enlarge and the surrounding hyphae, being closely woven together, cause them to coil up apparently. With further growth the surrounding tangle of hyphae is increased, the result of the multiplication and growth of the threads. Soon a well-defined perithecial wall is to be seen. "As this grows, it seems to spread so as to make more space within; the Woronin hyphae appear to lie loosely within the space enclosed. The wall increases in thickness rapidly, until it reaches a maximum thickness. After this stage, as the perithecium enlarges, the wall tends to become thinner but more dense." With the growth of the perithecium, the Woronin hyphae enlarge and the cells must divide, for there are more segments in the hyphae in the old perithecia. The segments enlarge considerably and are well-filled with homogenous granular protoplasm. The ends of the segments tend to become rounded so that the connection between the segments is very slight and they finally separate completely. Each seems to be an independent structure. The hyphae seem to be loosely coiled in the large space in the centre of the developing perithecium, but a

little later they come to lie near the perithecial wall. They all become more irregular, seem to lose much of their protoplasm, and take stains much less freely. "Later some of them send out branches and these branches give rise to ascogenous hyphae. Certain of the branches show large nuclei and become filled with very dense protoplasm. These hyphae seem to grow rapidly running along the inside of the perithecial wall. New growth springs from the inner portion of the perithecial wall, winds in among the Woronin hyphae and fills the centre of the perithecium." Fisch did not see the Woronin-hyphae at this late stage.

In *Xylaria tentaculata* the primary coil of the Woronin hypha is much more irregular than in the other species studied, some of the segments being considerably enlarged. "In almost every fruiting head more perithecia start to develop than can reach maturity on account of lack of space. . . . Probably most of the irregular segments of Woronin hyphae observed in sections of *Xylaria tentaculata* were in abortive perithecia, or in ones that would never reach maturity." Fisch observed the same phenomenon in *X. polymorpha* and Dawson in *Poronia punctata*. Both were of the opinion that they failed to develop on account of lack of food supply. Brown is inclined to agree, "for their development does not seem to depend on sexual phenomena."

The nuclei of the vegetative hyphae are small and numerous. In the Woronin hypha when first differentiated they are not very distinct, but after the segments have enlarged a rather large distinct nucleus may be seen in each segment. "In addition to the nucleus, there is also present one or more small masses of material which stains like chromatin or nucleoli. . . . They are usually located rather near the nucleus and the side nearest the nucleus was often flattened. . . . They may be extra nuclear chromatin." The Woronin segments next become multinucleate, twenty or more nuclei being counted. "As the Woronin segments branch the nuclei doubtless pass out into the branches. . . . The ascogenous branch that grows up to form an ascus shows a single large nucleus. It was not possible to follow the nuclei from branches of Woronin hyphae to this stage. They probably divide and multiply in the ascogenous hyphae for there are more asci produced than there were nuclei in the Woronin segments, and if we can consider comparative size as evidence, there has probably been a fusion of nuclei to form the large nucleus of the young ascus; it is considerably larger than any seen in the Woronin and ascogenous hyphae. There was no definite evidence of crosier formation. . . . A branch of an ascogenous hypha seems to form an ascus directly. The nuclei divide mitotically. But few details could be made out on account of their small size, and difficulties which were met in staining them."

As the perithecium grows there is an increased growth of threads from the inner portion of the perithecial wall. These threads are thicker than those forming among the Woronin hyphae and seem to be richer in protoplasm and have more nuclei. They extend from the wall and gradually fill the space within, forming the periphyses and paraphyses. "In most cases the points of origin of asci seemed to be evenly distributed over the sides and bottom of the perithecium but in a few perithecia they are somewhat clustered, the asci appearing to radiate from a few definite points. This was probably due to an aggregation of Woronin or ascogenous hyphae at these points." "The three species seem to be very much alike in finer structural characters. . . . Each segment of the Woronin hyphae is a cell differentiated for the purpose of reproduction, and it is possible that it is a degenerate female cell. Considering this and the fact that it gives rise to ascogenous hyphae, I believe that it should be regarded as an ascogonium." It will be remembered that Brooks (1910) working with *Gnomonia erythrostoma* found that the ascogenous hyphae have no connection with the ascogonium, and Blackman and Welsford (1912) found the same thing in *Polystigma rubrum*.*

Brierley (1913) has studied *Leptosphaeria Lemaneae.* Woronin (1870) worked out the principal points in the life history of this fungus, which is parasitic on the alga *Lemanea.* The hyphae run in a generally longitudinal direction and show two forms, the one consisting of fine, much branched threads, which by fusion at points of contact and by bridge connections, form an anastomosing cylindrical network; the other of fewer, stouter threads, little branched. The cells are uninucleate and regular. The contents frequently appear highly granular and occasionally minute, highly refractive substances are present. Arising as branches from this lumen mycelium is a weft of threads which spreads very extensively in an intercellular manner. It is from this portion of the mycelium that the fruiting bodies take origin. The mycelium exhibits hyphal dilations, terminally or in an intercalary position. These swellings may, or may not, be cut off by septa, and usually contain somewhat denser and more refractive contents. Neither conidia nor pycnidia were found. Woronin described a sexual process in this fungus but his account was questioned by de Bary. Brierley describes a sexual process of a different kind and one that is interesting in that it is similar to that described in a form of *Pleospora herbarum* by Cavara and Mollica (1907). "In macerations it was found, though rarely, that two hyphae were applied to one another, and that adjoining slightly dilated cells terminal or intercalary, or terminal with intercalary, shewed the appear-

* *Cf.* Trans. Brit. Mycol. Soc. IV., p. 146 (1913).

ance of fusion. In such cases one cell was apparently devoid of nucleus, whilst the contiguous cell contained two nuclei or a single nucleus of about twice the normal size. Microtome sections shewed in intercellular positions hyphal dilations containing two nuclei, and in cases where the adjoining cells could be distinguished there was good reason to think that fusion had occurred. Not infrequently such intercellular hyphal swellings contained a single nucleus of about twice the normal size." According to the author Woronin's "archicarp and applied hypha are exactly paralleled by mycelial dilations of purely somatic value." After fusion, fine hyphal branches arise from immediately adjoining cells and apply themselves closely about the ascogonium. The fusion nucleus divides and the ascogonium septates into a number of multinucleate cells from which the ascogenous hyphae arise. These branch freely and very irregularly and the nuclei pass into them in pairs. "Walls are laid down, and from apparently any of the binucleate cells thus formed asci may arise." The nuclei soon fuse in the asci. The sterile perithecial tissue between the asci is composed of uninucleate cells which do not stain. The asci develop rapidly and "the surrounding delicate thin-walled tissue subsequently becomes collapsed and devoid of contents, suggesting that it has functioned as nutriment to the developing asci." Two or three perithecia often develop in contiguity and the perithecial wall, in such cases, frequently remains undeveloped at the point of contact. The younger asci are situated principally at the periphery, and development proceeds in a centripetal direction. "The most careful examination of the nuclei failed to reveal the nuclear membrane, and all that could be seen was the prominent nucleolus, usually surrounded by a clear area of protoplasm. . . . The divisions within the ascus occur simultaneously and rapidly, but the minuteness of the nuclei rendered unsuccessful attempts to observe the mechanism of division."

It is surprising to meet with the occurrence of a true sexual process in a fungus in this group. Certainly one would not have expected to find the fusion of two uninucleate organs in such an advanced Pyrenomycete. The matter is of exceptional interest in many ways and it is to be hoped that the author, or some other worker, will give us a more detailed account of the essential phenomena of perithecial initiation.

In the Ustilagineae, Moreau (1913) has investigated *Entyloma Calendulae.* Dangeard (1894) studied *E. Glaucii* and recorded the occurrence of nuclear fusion in the spore. This fusion is now well authenticated.* It was not apparently Moreau's purpose to attempt to discover the mode of origin of the binucleate condition. The spores of the parasite form in considerable quantity

* Cf. Trans. Brit. Mycol. Soc. IV., p. 154 (1913).

and in fairly compact groups. They arise either along a filament or at its extremity. When young, each spore contains two spherical nuclei with a usually excentric nucleolus. The nuclei fuse and the nucleoli, at first diametrically opposite each other, approach and fuse. There results a single nucleus with an excentric or central nucleolus.

Several short papers have appeared giving details of nuclear history in the Uredinales.

Pavolini (1912) has studied the aecidium of *Puccinia fusca.** From the mycelial hyphae rise the regularly arranged vertical and parallel uninucleate cells. At first these cells are crowded and slender, then, at the age of binucleation, larger. There is practically no formation of intercalary cells; the cells are equally fertile, and as adult cells are frequently uninucleate this condition depends on their position in relation to neighbouring cells. Fusion occurs by the dissolution of the membrane of those cells which touch each other. No cells are binucleate until the stage when the aecidium breaks through the epidermis of the host. The author holds that it is more exact to call the "basal cells" of the aecidium simply hyphae. The binucleate cells only appear after the vertical rows are formed. The fusion of some fertile hyphae can only be observed in the upper layers when all the mycelial threads get together. The basal cells and all the hyphae coming from the basal hyphae have the same anatomical structure. The conjugate nuclei remain a certain distance from one another but their relative positions are not definite. The nuclei are strongly areolate and each has a prominent nucleolus. They are surrounded by finely granulated protoplasm. No proper karyokinetic figures were seen. The nuclear reticulation was not visible. Uni- and pluri- nucleate cells were not infrequent.

Dowson (1913) has studied the mycelia of *Aecidium leucospermum (Ochropsora Sorbi)* and *Puccinia fusca*. These fungi possess mycelia which perennate in the rhizome of *Anemone nemorosa*. Plants were obtained which were attacked by both fungi. The object of the research was to make out the distribution of the mycelia in the tissue of the rhizome, the nature of the haustoria and the number of the cell nuclei. The infected plants contained mycelia in their rhizomes, in the buds, sometimes in the terminal bud, and in the adjoining portions of the rhizome. The mycelium is in the plerom, periblem, dermatogen and in the meristematic tissue of the growing point, but not in the xylem and phloem. In the buds, the mycelium is intercellular; in the older parts, intercellular and intracellular. The intracellular mycelium grows through the pits in the walls of the host cell. Both parasites develop very complicated haustoria in leaves as well as root. These haustoria are of an irregular

* ? *Aecidium leucospermum. Puccinia fusca* is a micro-form.

crowded form and contain many nuclei. These nuclei are in many cases bent and of remarkable length. The young hyphae of *P. fusca* are thicker than those of *A. leucospermum*. The hyphae in the leaf are wider than in the rhizome, which agrees with de Bary's observations. The material showed aecidia in the one case and teleutospores in the other but was too old to show development stages. The mycelia in the rhizomes were uninucleate, as was also the old teleutospore in *P. fusca*. The aecidiospores and peridium cells of *A. leucospermum* were binucleate. The case of the latter fungus is interesting considering the life history as at present known in this country. The teleutospore stage is not yet recorded although the aecidial stage is far from rare. The aecidiospores are binucleate. Can the aecidiospore infect the *Anemone* plant and if so is there any difference in nuclear history from that which happens when the infection takes place by means of a sporidium?

The majority of rusts possess a mycelium which is localized and confined to rather a limited area. In a comparatively few species, the mycelium is not thus limited, but pervades practically the whole host plant; while in yet others, it at least permeates the host to some distance from the point of original infection often causing hypertrophy. De Bary pointed out that when the mycelium in unlimited infections passes into the perennial parts of the host plant (as e.g., into the rhizome of *Anemone nemorosa* in the case of *P. fusca* and *A. leucospermum*), the rust is itself perennial. Olive (1913) calls attention to a new kind of phenomenon in which two kinds of perennial mycelia were shown to occur in an intermingled state in the same host. One of the fungi studied was *Puccinia Podophylli*, in which Sharp (1911) obtained such abnormal results.* The latter recorded the occurrence of both uninucleate and binucleate mycelia. In the mycelium which is to give rise to aecidia and spermogonia a binucleate condition prevailed, although uninucleate cells were also occasionally observed. Several binucleate spermatia were observed and Sharp apparently inclined to the belief that the spermatia might in this instance arise from a binucleate mycelium. "Should it prove true that the spermogonia in this form arise from a mycelium which possesses conjugate nuclei, this would present a unique and truly startling fact, since in all other forms so far investigated, the spermatia are themselves uninucleate and arise from a uninucleate mycelium, hence being gametophytic structures." The results obtained in the present study seem to clear up many of the difficulties that Sharp's preliminary account raised. Teleutospores are ordinarily the first spore forms to appear, occurring on the leaf sheaths of very young plants of *Podophyllum* at the

* Cf. Trans. Brit. Mycol. Soc. IV., p. 158 (1913).

same time as, or even before, the spermogonia on the leaves. The teleutospores are very common while only a few plants show at the same time the spermogonial stage. These early teleutospores are well matured in most cases before any of the aecidia open. The appearance of teleutospores on certain leaf-sheaths is readily explained by the fact that these sheaths contain an abundance of binucleate mycelium scattered throughout their tissues. "The preparations also show, occasionally, a few aecidium cups on these same sheaths; but all such sori, so far as met with, are not quite ready to open and discharge their spores, as have many teleutosori of the same sections. . . . I have not yet found spermogonia on the sections of these young sheaths; but their occasional occurrence in such situations may be expected from the fact that a small amount of uninucleate mycelium occurs, especially in the region surrounding the aecial sori, these forming the meager pseudoparenchyma. But the rust mycelium of the sheath, in contradistinction to that in the young leaves, is undoubtedly prevailingly binucleate. Further, I am convinced that the aecidia which are borne on the sheaths arise, not from gametophytic cell fusions, but only from preexisting binucleate hyphae; therefore, being secondary and sporophytic in character, and thus similar in origin to the teleutospores." In the case of aecidial sori on leaves the mycelium in the young tissue is for the most part uninucleate. In the older leaves, however, in which the aecidia have begun to form their chains of spores, the binucleate mycelium has become very prevalent especially at the bases of the aecidia. "These sporophytic hyphae intermingle with the uninucleate mycelium, often entering the broad, caeoma-like base of the young aecidium, there functioning directly as basal cells of the rows of the binucleate aecidiospores. In still older stages on leaves, binucleate mycelium apparently prevails by the time the aecidium cups have for the most part broken open to discharge their spores, thus agreeing in such later stages with Sharp's too-generalized conclusions. That his conclusions are too general becomes obvious when it is remembered that, while it is true that binucleate mycelium prevails in the leaf sheaths of the young spring shoots and as well in the older leaf tissues; in the case of those young leaves which show externally an abundance of young spermogonia, uninucleate mycelium, on the contrary, undoubtedly predominates." In apparent agreement with Sharp, Olive finds that binucleate mycelium often invades the immediate neighbourhood of the spermogonia. "But I find no cases of isolated binucleate hyphae pushing up into the middle of a spermogonium. Contrary to Sharp's observations, I find no 'basal cells which bud off the spermatia' to possess more than one nucleus. Sharp found such lower cells to contain one, two or even three nuclei; and even the spermatia themselves

sometimes to contain two nuclei. The mature spermatia, according to my observations, each contain but one nucleus, and they arise invariably from a gametophytic mycelium. This type of mycelium, in my experience, is always made up of uninucleate cells, except of course for the short interval following nuclear division, and until the new wall has grown across the hypha to separate the two sister nuclei." Hyphae of the sporophytic mycelium dispose their nuclei similarly along the long axis of the cell; rarely are they side by side in such hyphae as they generally become in the sporogenous tissues. The two nuclei of such vegetative sporophytic cells divide apparently independently, although simultaneously or nearly so. The nuclei in these cells were never met with dividing in the side by side position characteristic of the commonly figured conjugate divisions of the later sporogenous tissue. "All of the spore forms so far described are products of the perennial, unlimited infection. In such an infection, the intermingled binucleate and uninucleate mycelia ramify more or less throughout the whole shoot. Besides this unlimited type of infection, local sori may also occur in the *Podophyllum* rust, in which the binucleate mycelium grows but a short distance from the point of original infection. I have preparations of this species in which the localized sori bear teleutospores, which we interpret as arising from aecidiosporic inoculations."

Another fungus investigated by Olive was *Puccinia obtegens*, a brachy-form which grows perennially in the rootstocks of *Cirsium (Cnicus) arvense*, observations made by the author leading him to the conclusion that the main method of distribution of the unlimited form of the disease occurs through the creeping rootstocks. Rostrup distinguished two generations in this fungus, a "first generation" or unlimited stage affecting the whole plant resulting in the appearance first of a multitude of pycnidia, covering the younger parts of the shoots, shortly followed by large, confluent sori of uredospores, among which are later developed a few teleutospores; and a "second generation," a strictly local infection in which only uredo- and teleutospores are produced and borne in small, scattered, rarely confluent sori. "Microscopic examination of the tissues below these localized sori revealed nothing but binucleate hyphae, as was to be expected, thus proving their secondary origin. Such local infections must, of course, have arisen from uredosporic infection, thus serving as the 'repeating stage.'" Olive's observations on the sequence of the spores in the unlimited generation agreed with Rostrup's description with one important exception. A few scattered plants instead of bearing pycnidia as the first spore form showed only uredo- and teleutosori. The surmise that such plants contained only sporophytic mycelium was shown to be correct as only bi-

nucleate hyphae were found in the tissues. "The microscopic preparations thus prove beyond doubt that the uredospores in such instances are secondary in their nature, since they arise from sporophytic mycelium." In other cases the sporophytic and gametophytic generations were shown to occur in an intermingled state growing throughout the host plant. Although uninucleate hyphae form the Anlage of the young uredosori in those leaves in which this kind of mycelium was abundantly present, they were not observed to fuse to form the uredospores. "Binucleate hyphae were instead seen to invade the uredosorus, pushing aside the uninucleate cells and producing directly the uredospores."

A third species *Uromyces Glycyrrhizae* (also a brachy-form) was investigated. As in *P. obtegens* the pycnidia first appear, and are followed by the uredospores, and as in that species plants occasionally occur showing only uredo- and teleutosori. Sections of such plants show only binucleate hyphae, "thus proving beyond doubt the secondary nature of the uredospores in these instances. Again, in the case of those young uredosori which accompany the pycnidia, although made up at first for the most part of uninucleate cells, binucleate hyphae may be seen to push up into the sorus and to form spores directly. Considerable search has failed in this, as in the two preceding species, to discover any gametophytic fusions, so that I should interpret this fact as indicating that the uredospores are all secondary in origin."

Thus three states of mycelial distribution are, at present, recorded for *Puccinia obtegens*: one, in which there occurs a perennial growth throughout the whole plant of mingled uninucleate and binucleate mycelium; another, consisting of an unlimited growth of binucleate mycelium only; and, thirdly, a strictly localized growth of binucleate mycelium. In *P. Podophylli* and *Uromyces Glycyrrhizae* two states: an unlimited growth of the intermingled gametophytic and sporophytic mycelia, and a localized growth of the sporophytic. The author has also herbarium specimens of the latter showing localized sori containing uredo- and teleutospores and presumably made up therefore of sporophytic mycelium. In cases where the two generations of mycelia are intermingled, the uninucleate appears usually to predominate in young tissues. In older and mature tissues the reverse is true. The uninucleate mycelium produces only the spermatia: these latter invariably arise from the gametophytic mycelium.

Olive's work is of the greatest value and clears up many difficulties met with when considering the formation of spores from a perennial mycelium. The presence of different types of perennating mycelium in the same plant is rather astonishing and the

search for the various theoretical possibilities in various rusts will prove an interesting study.

Kunkel (1913) has investigated the germination of the aecidiospores of *Caeoma nitens.* Tranzschel and Clinton both claim to have established by infection experiments that *Puccinia Peckiana* is the teleutospore stage of this fungus. When, however the aecidiospores were germinated, instead of giving rise to the usual binucleate sporophytic mycelium they produced a promycelium as is the genus *Endophyllum.** All the spores germinated in the same fashion. The promycelium ordinarily consists of five cells, four of which bear sporidia. On staining, it is seen that the stalk cell has no nucleus, and that the other cells contain one nucleus each, thus demonstrating the promycelial nature of the germ tube. There is sometimes a slight variation in the number of cells in promycelium and in the number of sporidia. Olive (1908) and Kurssanow (1910) have studied *Caeoma nitens* from a cytological standpoint and have shown that sexual fusions occur at the base of the aecidium and that the aecidiospores are typically binucleate. The aecidiospores have been germinated by certain observers but no production of sporidia was observed. It would seem that the fungus Kunkel has investigated is not the one studied by Tranzschel and Clinton, or that the latter workers have been misled. Sporidia giving rise to a mycelium producing teleutospores which would produce again a promycelium is at present unthinkable. It is not stated by the author whether he has considered the possibility of there being two different fungi under consideration. He intends, however, to test during the coming summer the connection between his plant and *Puccinia Peckiana.* The results of Olive and Kurssanow indicate that the same type of sexual process takes place here as in *Endophyllum Sempervivi* investigated by Hofmann (1911).

It is interesting to find that in a caeoma-type of aecidium, spores should be produced which germinate in the manner of teleutospores. This is the first case recorded—a peridium being present in *Endophyllum.* A new genus will probably be suggested on this difference.

Borggardt (1913) has studied the interesting *Uredo alpestris.* This fungus is known only in the uredo-form. Bock found that "die Überwinterung des Pilzes wird durch Uredosporen vermittelt," and also that "die Verbreitung des Pilzes wird im Summer ebenfalls durch die Uredosporen verursacht." Maire therefore suggested *Uredo alpestris* as a new type of Uredine (Pyro-Uredinales) which form uredospores only. He suggested that the other stages had dropped out of their life cycle and that they

* *Cf.* Trans. Brit. Mycol. Soc. III., p. 363 (1912).

were binucleate throughout their life history and comparable to one of the higher plants propagating solely by vegetative reproduction. As the germination of the uredospores had not been seen there remained some doubt as to whether a true uredo-form was in question and not a teleuto-form simulating a uredo-form. In the present investigation it was found in sections that the spores were binucleate as was also the mycelium everywhere. Binucleate cells were observed not only in the upper layer of the sorus where the spores are cut off but also very clearly in the lower portion. The paraphyses which surround the sorus are similarly binucleate. The binucleate condition is present in the young sori before the uredospores are formed. "Uredo alpestris wirklich eine Uredoform ist." We know that the uredospores can live through the winter. It is not, however, proved that the fungus has completely lost its teleutospores. It may be that under certain conditions these may still be formed.

Maire (1913) has studied *Mapea radiata* parasitic on the pods of *Inocarpus edulis.* Patouillard placed this fungus in the Uredinales, considering it as a uredo-form of a very peculiar type characterised by the waxy consistency and the radiate appearance of the sori. Von Höhnel suggested that it was only a young carpophore of *Marasmius* not yet provided with a stipe. On the evidence principally of figures, the spores described by Patouillard were interpreted as the cells of the covering of the pileus identical with those of *M. hygrometricus.* According to Maire, "cette analogie est plus apparente que réelle." The brush-like cells of *M. hygrometricus* are not normally caducous and their appearance is unlike that of spores. In their young stage they show a dikaryon* formed of two very small nuclei, poor in chromatin and absolutely identical with those of the vegetative cells. They accumulate no reserve food material and die early after thickening their membrane. The mycelium of *Mapea* is formed of filaments which penetrate the cells of the host as haustoria and there ramify abundantly. It is therefore intracellular and not intercellular as is the rule in the Uredinales. It produces a fairly considerable hypertrophy of the host cells and their nuclei. The immediately neighbouring cells are completely crammed with mycelium and lose all trace of protoplasm and nuclei. "Sur un stroma peu épais, non différencié, sans ancune ressemblance avec un primordium d'Agaricacée, se développent de nombreuses conidies ellipsoïdales, à épispore épaissi, verruqueux, qui naissent au sommet d'un pédicelle cylindrique unicellulaire." These conidia are caducous. They disarticulate easily from their pedicel. The mycelium is formed of cells with thick

* Pavillard has criticised the term *synkaryon* proposed by Maire to designate the two associated nuclei of the diplophase of the Uredinales, as this term has been employed by zoologists for the nucleus arising from the fusion of gamete nuclei. Maire (Mycol. Central. I., p. 214 (1912) therefore proposes to replace it by the term *dikaryon.*

walls more or less gelatinous externally, each provided with one or several pairs of nuclei. The spore and the pedicel both contain a pair of nuclei. "La spore a absolument la structure d'une urédospore. La structure des noyaux composant ces dikaryons, leur taille et leur richesse en chromatine les rendent tout à fait semblables aux dikaryons des Urédinales, et fort différents de ceux des Agaricacées, en particulier des *Marasmius*." Further the parasite observed in the wild state for several months has never shown any further development than that described by Patouillard. The author believes the fungus to show "une affinité étroite" with the Uredinales. The intercellular mycelium is a point of difference but this is exaggerated by the growth and ramification of the haustoria. The spores of *Mapea* have no visible germination pores in which they show resemblance to the uredospores of *Melampsora*, *Pucciniastrum*, *Hyalopsora*, etc. That *Mapea* may be regarded as a conidiferous Basidiomycete which has lost its basidia and acquired the structure of a uredine under the influence of parasitism is considered untenable. Such would certainly be a remarkable case of convergence and is not supported by any facts drawn from such genera as *Exobasidium*. In any case the genus *Mapea* must at present be conserved.

Moreau (1913) has made some observations on the centrosome in the Uredinales. The presence of the centrosome here is debated. Many observers state that it is present during mitosis but Sappin-Trouffy (1896) and Maire (1902) at no time observed it. Maire even considers the absence of a centrosome in the group as a character of degradation imposed by parasitism. "Si l'on considère d'autre part que le centrosome n'a été figuré qu'une fois, et avec doute, dans un noyau au repos par Olive (1908), on conviendra que son existence est l'un des points obscurs de la cytologie des Urédinées." The authoress has been able to show that the centrosome occurs apart from the periods of nuclear division. Its presence has been established in the caeoma which constitutes the second aecidial form of *Coleosporium Senecionis*, in the uredospores of *Melampsora Helioscopiae* and in the aecidiospores of *Aecidium Clematidis*. The aecidiospóres of *C. Senecionis* have large nuclei favourable for study, which usually show a large nucleolus and a clear nuclear membrane. In certain cases there is clearly seen on the membrane a small rounded corpuscle which is a centrosome. A chromatic body showing the same appearance but situated in the protoplasm at some distance from the nucleus has been met with in several aecidiospores. The centrosome is also present on the nuclear membrane in *M. Helioscopiae* and *A. Clematidis* but here the nuclei are of small size. Arnaud (1913) has also studied the nuclei of *Coleosporium Senecionis*. He had previously* worked with *Capnodium meridionale*

Cf. Trans. Brit. Mycol. Soc. IV., p. 149 (1913).

but the scarcity of mitoses and the small size of the nuclei prevented a complete study of the phenomena. Judging from the drawings of *Coleosporium* given by Sappin-Trouffy, Arnaud considered there might be some analogy between the nuclear divisions in the two cases. "Il est facile de se rendre compte que les mitoses observées sont identiques à celles qui ont été décrites en particulier par M. Maire, chez les Eu-Basidiomycètes et par Blackman chez les Urédinées, ce qui nous dispense d' entrer dans le détail." Maire indicated the presence of two chromosomes in the Eu-Basidiomycetes. This stage is preceded by others where there are a greater number of chromatin bodies called by him protochromosomes. "Nous avons observé ces derniers stades, mais nous n'avons pas pu acquérir une certitude parfaite sur la valeur exacte des *chromosomes* et des *protochromosomes*. Cependant nous serions plutôt porté à considérer comme vrais chromosomes certains protochromosomes de Maire." At a certain stage these bodies shown in *C. Senecionis* a fairly well-defined form—"en accent circonflexe" while the later bodies have an irregular form as indicated by Maire. This stage is also present in *Capnodium meridionale* and in the drawings given by Harper for *Phyllactinia*. The author has also observed it in an immature Sphaeriaceous fungus (*Pleospora* or *Mycosphaerella*). Fairly often the protochromosomes in *Coleosporium* are compact enough to give the appearance of two simple masses. "Quelle que soit du reste le nom que l'on doive donner à ces corps, il semble bien que ces formations soient homologues, chez les Urédinées, les Eu-Basidiomycètes et les Pyrénomycètes. On peut penser que la mitose se fait suivant un procédé analogue chez tous les champignons supérieurs." At the end of the division the chromatin is disposed in two annular masses one at each pole. Each mass shows lobes which probably indicates joined chromatic bodies. Centrosomes and asters are generally very clearly visible during the division. Some of the nuclei presented very curious appearances, showing divergent filaments staining like the spindle. In certain cases masses of chromatic granules were observed in the protoplasm. In the young binucleate teleutospore are seen slightly stained lines joining some of the chromatic granules of the two nuclei. It must be said that the author's present account taken together with his figures is much more convincing than the one reviewed in last year's *résumè*.

In the Basidiomycetes Levine (1913) has published his results on the cytology of certain Hymenomycetes, chiefly Boleti. Since Brefeld's work on *Coprinus stercorarius* it has been regarded as established that no specialized sexual organs are present in this group, although Hartig believed that the clamp-connections (usually regarded as concerned with food transportation) brought about a cell union resembling a sexual act. It is known that a

series of binucleate cells lead up to the basidia and that there a fusion of nuclei takes place. How this binucleate stage is initiated is the problem facing cytologists working on this group. In *Pholiota praecox* Levine found that the spores in germination do not swell or burst but push out a dense globular bud at the apical end, opposite the point of attachment. This bud is very dense and at first contains no nuclei. It grows rapidly into an ordinary germ tube and a nucleus appears in it soon followed by another. "I have not seen nuclear division figures at this stage, but soon two, four, and more nuclei can be found in the germ tube lying near the spore." The main germ tube is an outgrowth of the initial globular head which is more or less permanent. The cytoplasm shows a reticulate structure with larger, more or less numerous vacuoles. The nuclei are irregularly distributed through the cytoplasm and show no definitely paired arrangement. Few, if any, cross walls have been formed at this stage and the hyphal cells are beyond question multinucleate. The nuclei are very small, but show a distinct nuclear membrane, a nucleolus, and granular chromatin. New branches are formed (up to the forty-eight hour stage) from the bulbous initial bud of the spore as well as from the main germ tube. The lateral branches generally show several nuclei which are similar in all respects to those in the main germ tube. Sections of material three days old show both binucleate and uninucleate cells making up the mycelium. "Long multinucleated cells are also found, which are the germ tubes of spores that germinate late." The cytoplasm is less dense in these uninucleate hyphae and stains better. The vacuoles are large and extend across the entire width of the cell. The structure of the nuclei shows very clearly, the chromatin being composed of delicate strands distributed irregularly through the nuclear cavity. The nuclei of the binucleate cells are smaller but show the same structure. In cultures three days old clamp connections and hyphal anastomoses were first noticed. In cultures seven days old the mycelium shows considerable numbers of multinucleate cells which resemble those of younger cultures. Binucleate cells appear more frequently and uninucleate cells are also observed occasionally. Clamp connections may be seen at one or both ends of the cells and are very common. At this stage the usual small concavo-convex metachromatic granules appear on both sides of the cross walls of the hyphae. Hyphal anastomoses are also present. The mycelium of *Collybia velutipes* was studied for comparison. The mycelial cells are binucleate. Narrower hyphae densely filled with cytoplasm were also found. The terminal portions of these filaments become divided into uninucleate cells which give rise to the uninucleate oidia described by Biffen. Clamp connections and hyphal anastomoses are present.

In *Polyporus adustus*, *P. betulinus*, *P. destructor* and *Polystictus versicolor*, clamps are abundantly present. Brefeld described clamp connections as being cut off by walls from each of the cells which they join, but that is not the case here. "Only one cross wall is formed separating the clamp from the cell from which it arose. In well stained preparations hemispherical pads . . . are visible on both sides of this cross wall in the clamp. This perhaps indicates only a partial closing up of the opening originally present." Similar pads may be seen on the septa between many of the hyphal cells. Hyphal anastomoses in these mycelia are also common. The hyphae are made up of a series of regularly binucleate cells. In the mycelium of *P. versicolor* undoubtedly uninucleate cells are also present but they are not common. "The mycelia in cultures of *P. destructor* and *P. betulinus* may show non-nucleated cells which are joined to adjacent binucleated cells by hyphal anastomoses and clamps."

The cells of *Coniophora cerebella* are regularly binucleate; clamps and hyphal anastomoses are also present.

Longitudinal sections of all parts of the stipe of *Boletus granulatus* show it to be composed of an undifferentiated mass of interwoven hyphae. The hyphal cells towards the centre of the old stipe are more loosely interwoven as compared with the periphery (Ruhland's plectenchyma). The cells vary in diameter. The cross walls show the so-called protoplasmic connections. "Clamp connections on hyphal anastomoses are entirely lacking." Many cells in the plectenchyma are binucleate but the majority are multinucleate. The distribution of these cells is not regular although there is a tendency for the cells in the centre of the stipe to become multinucleate. The method in which this arises was not worked out but according to Maire this multinucleate condition is the result of an amitotic division of the two original nuclei in the cell. The cytoplasm in the cells of the stipe contains very large vacuoles. The nuclei are comparatively large and nucleolate. In very old stipes the comet-shaped nuclei figured by Ruhland also appear. The cells of the trama, subhymenium, hymenium and annulus are binucleate. The cells of the flesh of the pileus are short and almost invariably binucleate: In a few cases tri- and quadrinucleate cells were met with. "Frequently in the nuclei of the ring, flesh, and trama a darkly staining granule is found on the nuclear membrane, to which the chromatin of the nuclei seems to be attached. The position of this body varies; it is sometimes found lying opposite the nucleole but frequently it is near it. This body resembles the central body described by Harper (1905), for the mycelial nuclei of the mildews." The terminal branches of the tramal hyphae may be traced

directly into the subhymenium. The basidium cells are formed as in all other cases by the division of the subhymenial cells. "I have not been able to find nuclear or cell division figures at this stage." The mother cell divides and the outer cell thus formed may become either a basidium or a cystidium. "It seems to me that in all cases the paraphyses are really immature basidia." The cystidia of Boleti appear either singly or in clusters: in *B. granulatus* such clusters are covered by a gelatinous excretion. Cystidia in all stages of development may be found in a single cluster. "The young cystidium shows a dense granular cytoplasm, which is somewhat fibrillar in the upper part of the cell; vacuoles are also present. The young cystidium is regularly binucleated; the nuclei are in all essentials similar to those found in the basidium." The subhymenial cell from which the cystidium arises is proportionately larger and may be frequently traced back into a long filament of binucleate cells in the trama. "The evidence is clear that the cystidia, in *B. granulatus* at least, are glandular structures. The two nuclei are small in proportion to the volume of the cell. . . . The formation of mucilage does not take place through any specialized pore as Massee (1887, 1904) holds, nor is it associated with any localized region of the cystidium as Maire (1910) and Knoll (1912) contend, but apparently takes place over the entire surface of the cystidial cell." Later the cystidium begins to disintegrate. The basidial nuclei are quite favourable for study. The cytoplasm of the young basidium is finely vacuolar. With the growth of the basidium, the nuclei also increase in size. Fusion stages are abundant. The chromatin in the nuclei before fusion loses its reticulate structure and a number of strands appear. The nuclei during fusion become appressed upon each other and the nuclear membranes disappear in the region of contact. Thus a bilobed structure is formed which lasts a long time. The constriction gradually disappears. "The method of union of the chromatin masses is not easy to make out. The strands soon become mingled so as to be indistinguishable as to their origin. I am inclined to believe, however, that the union is nothing more than the approximation of the chromatin strands bringing them into close contact with each other side by side." The nucleoli approach, come into contact with each other and eventually fuse. The basidium continues to grow and larger vacuoles appear in its cytoplasm. The secondary nucleus lies in the centre of the basidium and enters a resting period. At this stage, in *B. granulatus*, *B. albellus*, *B. versipellis*, *B. indecisus* and *Strobilomyces strobilaceus*, a dense oval body is found lying in various positions in the basidia. Radiating from it are long strands of kinoplasm. Levine could not connect this body with the processes of nuclear division though in some cases it resembles the archeoplasmic

masses figured by Wager (1894) in *Mycena galericulata* and considered by him to be the origin of the centrosomes and karyokinetic figures. The first division usually takes place in the upper part of the basidium, although the prophase stages begin while the nucleus is still near its centre. The chromatin strands combine to form a spirem—resembling in many cases a postsynaptic spirem. A parallelism of spirem strands was also found suggesting splitting. The spirem then segments. "The number of these chromatic segments apparently varies and it is very difficult to count them." During division a large vacuole appears at the base of the basidium. "The nucleus moves towards the apex of the cell and the spindle figure appears." The nuclear membrane disintegrates and the nucleolus is found in the cytoplasm. The direction of the spindle does not always conform to the generally accepted view of Juel: while the transverse position is common the spindle is often decidedly inclined. The poles of the spindle end in small centrosomes from which long streaming rays extend to the centre of the basidium (cf. Maire, *Boletus regius*). Well developed polar asters were found in many *Boletus* spp. "The number of chromosomes is difficult to determine but in favorable sections I have been able to count from six to eight." They lie, as described by many authors, in the centre of the spindle although no characteristically dense equatorial plate is formed. The chromosomes are drawn to the poles and at the same time the spindle elongates until its ends touch the basidium wall. The resulting daughter nuclei resemble in all respects the mother nuclei. They prepare immediately for a second division, the prophases of which are hard to study. The spindles show centrosomes with long astral rays. The nuclear membranes still persist at the equatorial plate stage. The number of chromosomes was demonstrated to be always more than two at the poles. The secondary spindles may become elongated until the chromosome masses reach the wall of the basidium as in the first division. The young daughter nuclei grow rapidly in size and remain for some time attached to the basidium wall. "They then begin to move downward toward the base of the basidium and it at once becomes evident that they are connected by faintly stained strands with small granules which lie on the upper wall of the basidium at the point from which they started. The origin of these granules cannot be easily determined." From their reaction to stains, size and position it appears that they may probably be the centrosomes which became fixed to the basidium wall in the process of division. The position of the centrosomes on the upper part of the basidium wall indicates the position of the future sterigmata. "I believe the fibrillar strand possibly

may be analogous to astral rays." As the sterigmata bud out the centrosomes and strands are carried upward, the centrosomes remaining at the apex of the sterigma. The spore initial appears at the end of the sterigma and grows rapidly. From the centrosome on the upper, inner surface of the spore wall the fibrillar strand passes down through the sterigma to the nucleus of the basidium. The centrosome seems to mark the apex of growth for the spore as well as for the sterigma. In the spores of *B. castaneus* a number of fibrils radiate downward from the centrosome through the cytoplasm but the strand which runs to the nucleus is thicker than the others. These fibrillar strands were present in practically all the Boleti studied: also in *Merulius tremellosus*. In *Polyporus brumalis* and *Fomes lucidus* they could be traced only from the sterigmata to the nuclei. Simultaneously with the development of the spores the nuclei begin to move towards the sterigmata probably as a result of the contraction of the kinoplasmic fibrils. The nucleus divides after entering the spore. Division figures were seen in the spores of many species. These are small but very sharply differentiated with well-developed centrosomes and polar asters. The chromosomes are so small and so massed together that their numbers cannot definitely be counted although there are certainly more than two. The spindle is either parallel with or transverse to the long axis of the spore. The two daughter nuclei show all the essential features of the nuclei in the basidium. In the spores of *B. albellus* a second division occurs. The spindles are parallel or at right angles. The chromosomes are more than two in number. The division is apparently not conjugate though simultaneous.

The species of *Boletus* in which Levine found binucleate spores and binucleate cells in the hymenium and subhymenium are, in addition to those mentioned:—*B. alutarius*, *B. badius*, *B. bicolor*, *B. chrysenteron*, *B. cyanescens*, *B. felleus*, *B. glabellus*, *B. griseus*, *B. luridus*, *B. ornatipes*, *B. pallidus*, *B. punctipes*, *B. regius*, *B. scaber*, *B. spectabilis*, *B. subtomentosus* and *B. vermiculosus*. It would have pleased cytologists more if the author had investigated the origin of the conjugate nuclei in one or more of these forms, which, judging from the account given of the division of nuclei in the spore, should prove a satisfactory genus to study. Levine adds nothing concerning this point to what was already known from the work of Nicholls.

Kniep (1913) seems to have been more successful. Working with *Coprinus nycthemerus* he obtained the following results. When the spore germinates, the membrane bursts and a broad bladder-shaped protrusion is put out. From this then grow one or more narrow hyphae which soon branch and even anastomose. The cells of the young mycelium are preponderatingly uninu-

cleate. The original flask-shaped germination tube is often uninucleate but it may contain several nuclei (usually not more than four), the number depending upon the size of the cell. As growth continues the mycelium becomes somewhat broader; the length of the cells is subject to large variations. Mitoses were only seldom seen in the mycelium and the nuclear figures were so small that the chromosome number could not be made out. Clamp connections are met with after several days' growth. The cells of the young mycelium are mostly uninucleate. Later binucleate cells are frequently met with in the clamp-free mycelium: tri- and quadrinucleate cells were seldom observed. The characteristic rod-shaped oidia, described by Brefeld for various Coprini, were met with in great quantity, always on the uninucleate mycelium. The cells of this are relatively short and rather barrel-shaped. The cell giving rise to the bush of oidia is always uninucleate (Maire [1902] also found this in *C. radiatus*). The young fruit bodies appear essentially, but not exclusively, on the mycelium possessing clamp-connections. The line between the two types of mycelia is by no means sharply defined, as they can both occur alternating in the same mycelium. The clamp arises as a sort of side branch immediately above a cross wall and bends in applying itself directly below the wall. The mother cell is cut off, and then the apex of the branch fuses with the lower cell. Apparently the second wall cutting off the clamp from the lower cell which Brefeld described, was not present in this fungus (cf. Levine *supra*). As the clamp first forms there are generally seen two bodies lying closely together, a smaller usually round strongly staining body and a larger one of different shape which stains less. They usually lie in the apex of the outgrowth, and are well seen before the fusion of the cells but are still visible after the union takes place. They are no longer apparent in the older clamps and the author considers that they degenerate. The origin of these bodies was not made out. The question as to whether they might possibly be nuclei was fully considered but "aus alledem glaube ich schliessen zu dürfen, dass diese Körperchen keine Kerne sind."

The fruit bodies always arise directly upon the mycelium. They arise as one-celled side branches, with binucleate cells and rich contents. "Wesentlich ist aber, dass im vegetativen Mycel die zweikernigen Zellen keine regelmässige Erscheinung sind, während das in den Fruchtkörperanlagen der Fall ist." On the cross walls are clamp connections. The carpophore does not usually arise from a single side branch, but from many such either from the same or from neighbouring hyphae, which become entangled into a ball. The side branches may arise from uninucleate cells. It is clear from the author's observations, "dass das regelmässige Auftreten von Kernpaaren erst mit der

Bildung der Fruchtkörper einsetzt." The binucleate condition arises in the single-celled beginning of the carpophore and lasts until the fusion of the nuclei in the basidium. Although the first cell may be joined to the cell from which it arises by a clamp connection yet this is in no way a sexual process. Both nuclei are present in the cell before the connection takes place. "Es kann wohl keinem Zweifel unterliegen, dass das Kernpaar diese Anlage durch einfache Kernteilung zustande kommt," and that there is no migration of nuclei as in the Uredineae and the Ustilagineae. It was not made out whether this division usually takes place in the side branch or in the cell from which it arises. Only one figure of what appeared to be conjugate division of a pair of nuclei was met with. In fruit bodies a little older, the cells of the universal veil have many pairs of very small nuclei, as well as metachromatic bodies. The older cells of the volva have also paired nuclei as Maire also found in *C. radiatus*. As Harper showed in *C. ephemerus*, the cells of the stipe in *C. nycthemerus* are very large and contain very many nuclei embedded in a central plasma mass, but afterwards seem to be arranged in pairs. The cells of the trama and the paraphyses are binucleate. The development of the basidium shows no peculiarities.

Kniep has also studied the life history of *Hypochnus terrestris* (n. sp.). Here the basidia are freely formed and are found sometimes on a loose, sometimes on a rather dense hymenium. The mycelia on the end of which the basidia arise are binucleate. The two nuclei usually lie rather close together. The nucleoli lie in the peripheral region of the finely granular nuclear mass as is characteristic in the Basidiomycetes. The young basidia scarcely differ from the underlying supporting cells but soon the nuclei with their nucleoli grow strongly both in mass and substance. At the same time the basidium grows and swells somewhat at the tip. The nuclei fuse immediately to form a secondary nucleus. This appears to happen rather quickly judging from the infrequency of fusion stages. All stages of basidial development are seen in a single hymenium. The secondary nucleus lies usually at or near the middle of the basidium. As the basidium increases in size the plasma gathers generally in the apical region whilst the lower portion becomes vacuolate. The nucleus soon shows signs of heterotypic division. The characteristic synapsis stage was clear; then follows the post-synaptic spirem. These stages were often met with. The nucleus then wanders to the apex of the basidium. The typical diakinetic figures were seen. The chromatin rounds up into rather small, strongly coloured bodies which are probably to be regarded as chromosomes. They later group themselves into four pairs. The nuclear membrane disappears and a multipolar spindle arises which afterwards be-

comes bipolar and the chromosomes arrange themselves on the equatorial plate. The nucleolus has now disappeared. At each pole a small body is present which is probably a centrosome. The number of chromosomes appears to be eight. The homotypic spindles are smaller than the heterotypic and "scheint es mir keinem Zweifel zu unterliegen, dass die haploide Chromosomenzahl 4 ist." The daughter nuclei quickly form and at or immediately after this stage wander downwards in the basidium. The sterigmata then arise and when the spores begin to form the nuclei again pass upwards and through the sterigmata into the spores. The nuclei either divide while passing through the sterigmata as Fries thought for *Nidularia*,* or immediately after entering the spore. The division was not seen. Binucleate spores are, of course, far from unusual. In *H. terrestris*, however, this binucleate condition is especially interesting as the nuclei give rise immediately to the binucleate generation. "Einkernige Zellen oder Zellen mit einer unbestimmten, variierenden Kernzahl kommen nämlich im Mycel dieses Pilzes gar nicht vor. Sämtliche Zellen sind zweikernig, von der spore bis zur jungen Basidie." Nuclear divisions in the mycelium were rarely met with. During division the spindles always lie near to one another and are parallel or inclined at an acute angle. The number of chromosomes was not established but it appeared similar to the haploid number. The four nuclei formed from this division move in pairs away from each other while the mycelium increases in length. Then a cross wall appears between the pairs. The mycelium grows and branches and is built up completely of binucleate cells.

Thus in this fungus we have a sporophytic stage which lasts practically throughout the life history. The uninucleate condition is exceedingly abbreviated, being merely the stage between the last division in the basidium and the division in the spore. This predominance of the binucleate condition recalls the similar state of affairs in *Ustilago Carbo*.†

Moreau (1913) has studied the cytology of an interesting abnormality in *Psathyrella disseminata*, where the gills do not produce basidia but divide into rounded fragments. Berkeley on first meeting with this phenomenon made it the principal characteristic of a new genus which he called *Rhacophyllus* but Patouillard has since found the abnormality in several agarics, and considers them merely forms of known species. Although he was unable to germinate the fragments he considers they are bulbils. These small round bodies are connected by rare, lax hyphae which are connected with the hyphae forming the external covering of each bulbil. "Ces hyphes son ceux du Champignon lui-

* *Cf.* Trans. Brit. Mycol. Soc. III., p. 364 (1912).
† *Cf.* Trans. Brit. Mycol. Soc. IV., p. 156 (1913).

même et non ceux d'un parasite." Each bulbil is a cellular mass, a kind of sclerotium, formed of polyhedral cells without intercellular spaces. The protoplasm is somewhat dense with fairly rarely one or two vacuoles. They are usually binucleate. The nuclei approach and fuse. Afterwards the fusion nucleus divides by mitosis. It is a true karyokinesis with a nuclear spindle, two centrosomes and two chromosomes. (This is the chromosome number recorded by Maire in *Psathyrella disseminata*.) A further division takes place and the cells become quadrinucleate, although sometimes a supplementary division takes place and the cells then contain six nuclei. " Ce sont précisément les phénomènes qui prennent place dans les basides. Chaque cellule des bulbilles se présente donc, envisagée au point de vue de l'histoire de ses noyaux, comme l'homologue d'une baside." Afterwards two of the four nuclei degenerate and the original binucleate condition of the cell is restored. Judging from the number of binucleate cells and the nuclear fusions met with the author thinks that the fusion and the first division take place in all, or practically all, the cells. The second mitosis he considers does not occur in all as the quadrinucleate condition and that in which two of the nuclei are disorganising are relatively rare. Strange to say, the wall between two contiguous cells fairly often breaks down and the cell contents fuse thus producing cells with four, six or eight nuclei. " Ces fusions de cellules sont sans doute en rapport avec la fréquence des anastomoses de filaments et la formation des boucles chez les champignons supérieurs. Etant donnée l'homologie des cellules qui les présentent avec des basides on peut croire que ces fusions sont l'équivalent de la production par une basidie normale, hors d'elle-même, de basidiospores, ce phénomène étant modifié du fait que les cellules sont plongées au sein d'un massif cellulaire." It would be interesting to ascertain whether such abnormal plants would breed true to their bulbils. Also whether the two nuclei in the mature cells of the bulbil are the first of the conjugate nuclei. Moreau suggests that if the abnormality is dependant upon external conditions we should have a fungus possessing two modes of sexual reproduction. It is difficult to see how this can be, accepting Dangeard's (and Moreau's) view that the fusion of the nuclei in the basidium represents the sexual process. The fusions in each case are apparently homologous. A point worthy of study would be whether the binucleate condition arises in a different manner in the two cases.

Dumée and Maire (1913) have published a note on *Queletia mirabilis*, the first named having been so fortunate as to discover numerous specimens of this remarkable fungus—apparently the seventh record. The authors found that the development and

ripening of the spores takes place while the fungus is still buried in the substratum and it is only when the spores are ripe that the foot develops and pushes up the sporiferous receptacle. The basidia (which were previously unknown) are fairly difficult to find when the growth of the fungus is not followed, for their development is extremely rapid and their disappearance very precocious. "Il faut donc, pour étudier les basides de *Queletia* choisir des spécimens dans lesquels la gleba va se teinter. Les basides sont irrégulièrement disséminées dans la gleba, sans former de couche hyméniale, tapissant des cavités internes: le *Queletia* est donc *plectobasidié*." The hyphae of the gleba are composed of cells which possess a single dikaryon or several if they are elongated. It is these latter that produce the filaments of the capillitium. On these hyphae, the basidia arise as short branches. They soon become claviform and possess then a single large nucleus. This nucleus divides and gives rise to four nuclei. At this time three large sterigmata form, one near the summit of the basidium, the others on the sides. At the end of each sterigma a spore develops into which a nucleus passes. The fourth nucleus remains in the basidium and there degenerates. The basidium often takes on a more or less irregular form. Unisporic and bisporic basidia are sometimes met with. A wall is formed in the middle of the sterigma and the disarticulation taking place here the detached spore retains the upper portion of the sterigma. The authors promise a detailed anatomical and cytological account of the fungus.

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NEW BRITISH FUNGI.

By John W. Ellis, M.B., F.E.S.

Phyllosticta Sorbi, West. Bull. Ac. Belg. II. Ser. XII. n. 71; Saccardo Sylloge Fung. III. No. 26.

Spots more or less circular, discrete or confluent, ashy-grey with purplish-black margins; perithecia punctiform, black, clustered towards the middle of the spots, pierced with a pore; spores ovoid, $10\mu \times 5\mu$, hyaline.

On the upper surface of the leaflets of Mountain Ash (*Pyrus Aucuparia*), Bidston (Cheshire), November 8, 1913.

Saccardo records this species from Belgium and Portugal. My specimens agree with the above description except that the spores are slightly smaller, averaging about $8\mu \times 4\mu$.

Phyllosticta Opuli, Sacc. Mich. I., p. 146. Sylloge III., No. 77.

Spots epiphyllous, sub-circular, occasionally confluent, dry, ochraceous, becoming white in the centre with a broad dark purple-brown border; perithecia prominent, few, somewhat scattered, 1/10 to 1/8 mm. diam., fuscous, opening by a pore; spores oval or elliptic oblong, with rounded ends, unicellular, $5\text{-}7\mu \times 2\text{-}2\frac{1}{2}\mu$, hyaline.

On leaves of *Viburnum Opulus*, Great Storeton, Cheshire, August 23, 1913. Recorded by Saccardo from Northern Italy.

Phoma strobiligena Desm. f. *microspora* Sacc. (See Trans. Brit. Mycol. Soc. IV., 124.)

Probably not really different from the type, for in cones of *Pinus sylvestris* gathered at Bidston (Cheshire) I find the spores vary from $4\mu \times 2\mu$ to $5\text{-}8\mu \times 3\text{-}3{\cdot}5\mu$, about $5\text{-}6\mu \times 3\mu$ being the most prevalent.

Phoma occulta, Sacc. Cfr. Fuck. Symb. App. III., p. 23. Sacc. Sylloge III., No. 893.

Perithecia at first sub-epidermal then breaking through the cuticle with a longitudinal fissure. The subglobular perithecium, which ultimately opens by a minute pore, becomes surrounded by the raised and torn margin of the epidermis. Frequently the surface of the scales on which perithecia are

present is stained black. Spores oblong-ovate, with or without guttulae, $7\text{-}9\mu \times 1{\cdot}5\text{-}2{\cdot}5\mu$.

On scales of Spruce-fir, Brace's Leigh Wood, near Malvern, May 1912, and Nannau Woods, Dolgelley, May 1913.

Said by Saccardo to be the conidial stage of *Diaporthe occulta* Fuck., an ascomycete which appears to be generally distributed throughout Europe on the cones of Fir and Cypress, and which has been recorded on Fir-cones at Eastbourne (Grevillea III., 68).

Coniothyrium sphaerospermum Fckl. Symb. Myc. 377; Sacc. Sylloge III., No. 1731.

M. C. Cooke in his list of British Sphaeropsideae (Grevillea XIV.) records this species on *Ulex*, in the New Forest, and I am not able to find any further record of its occurrence in Britain. I have lately found it quite abundant near Bromborough (Cheshire) on dead spines of *Ulex europaeus* and on pods of Laburnum, and in one case I found a perithecium containing asci and spores of *Pleospora Pisi* Sow. surrounded by spores of *Coniothyrium*. Cooke (Handbook, II., 897) regards *P. Pisi* as a form of the abundant *P. herbarum* Pers., but as the latter species seems to be invariably preceded by the conidial condition known as *Phoma herbarum* West, with oblong-elliptical hyaline spores, and as I have never found any *Pleospora* on a leguminous plant attended by this *Phoma* stage I believe the presence of the *Coniothyrium* (with subglobular, yellow spores) to indicate the desirability of still regarding *Pleospora Pisi* Sow. as a specific entity.

ASCOCHYTA SPARGANII *nov. sp.*

Peritheciis minutis (40μ diam.), globoso-depressis, poro pertusis, nigris, gregariis in maculis elongatis flavis; sporulis oblongis, utrinque rotundatis, uni-septatis, leniter constrictis, $16\text{-}18\mu \times 6\text{-}7\mu$, hyalinis.

In foliis *Sparganii ramosi*, Rodborough Common (Surrey), September 25, 1913.

The perithecia are so small as to be scarcely visible to the unaided eye, and they are grouped in more or less elongated patches on conspicuous yellow blotches on both sides of the leaves.

Hendersonia Henriquesiana Sacc. et Roum. Rel. Myc. Libert, Ser. IV. No. 148. Sylloge III. No. 2332.

Perithecia subglobular, $\frac{1}{4}$mm. diam., beneath the wrinkled epidermis which is raised and pierced by a circular or stellate opening. Spores fusiform, obtusely pointed, 3-septate, scarcely constricted at the septa, pale yellow-brown with the proximal

cell hyaline, $12\text{-}16\mu \times 5\text{-}6\mu$; on slender, filiform, hyaline sporophores, $20\mu \times 2\mu$.

On shrivelled Rose-hips, Kirkby Stephen (per Thomas Gibbs, Wirksworth).

Saccardo's record is from putrefying fruit of *Rosa villosa*, Malmedy in the Ardennes (Libert).

Septoria Euonymi Rabh. Flora 1848, p. 506; Sacc. Mich. I., p. 172; Sylloge No. 2595.

Perithecia minute, sub-convex, black, sparingly scattered over pale brownish-grey spots that usually occupy the apical half of both surfaces of the leaves. Spores filiform, straight or slightly curved, sparingly (2-5) septate, $20\text{-}40\mu \times 2\text{-}3\mu$, hyaline.

On leaves of *Euonymus japonicus*, Sefton Park, Liverpool, April, 1913. In association with abundance of *Cytospora foliicola* Lib.

According to Saccardo this species is a native of Germany and Northern Italy, but the shrubs upon which it occurs have been in Sefton Park many years.

SEPTORIA TARAXACI *nov. sp.*

Maculis epiphyllis, orbicularibus, brunneis, nigro-cinctis, tandem confluentibus; peritheciis sparsis, minutis ($\frac{1}{8}$ mill. diam.), fuscis, poro pertusis; sporulis protrusis in cristulis albis, bacillaribus, rectis vel leniter curvatis, utrinque obtusis, uni-septatis, usque ad $25\mu \times 3\mu$, hyalinis.

In foliis *Taraxaci officinalis*, Thurstaston (Cheshire), July, 1913.

Leptostroma Stellariae Kirchn. Lotos, 1856, p. 204; Sacc. Syll. III., No. 3449, and XVI., p. 990.

Perithecia epiphyllous in more or less longitudinal series on the withered leaves, circular to elongate-elliptical, convex, smooth, black, at first even then splitting longitudinally in a hysteriform manner; spores ovate-oblong to cylindrical, obtusely pointed or rounded at the ends, $9\text{-}12\mu \times 2\text{-}2{\cdot}5\mu$ (in my specimens $7\text{-}9\mu \times 2\mu$), hyaline, with two guttulae.

On withered leaves of *Stellaria Holostea*, Bromborough (Cheshire), November, 1913.

Probably the conidial condition of *Phyllachora Stellariae* Lib., for in one of the perithecia examined there were a few asci filled with granular matter but no trace of ascospores.

Leptostroma Stellariae has been recorded from Holland and Bohemia, but the *Phyllachora* seems to be widely distributed on the Continent. Neither have, so far as I am aware, been recorded from Britain.

GLOEOSPORIUM LONICERAE *nov. sp.*

Maculis epiphyllis, subcircularibus, tandem confluentibus, rufobrunneis, fusco marginatis; acervulis numerosis, in medio maculorum congestis, epidermide velatis, mature apertis, saepe confluentibus, nigris; conidiis ovoideis vel oblongo-ovoideis, apice rotundatis, basi attenuatis, subacutis, rectis vel curvatis, continuis, 20-25$\mu \times$ 6-7μ, hyalinis.

In foliis vivis *Lonicerae Periclymeni*, prope Keswick (Cumberland), July, 1913 (per Miss B. O'Loughlin).

PLEOSPORA HEPATICOLA. SP. NOV.

By W. Watson, B.Sc.

During the examination of some liverworts in the field, a number of small black bodies were noticed on the leaves. On examining the material under the microscope the black bodies were seen to be the perithecia of a pyrenomycetous fungus, and as I was unable to find any described species which corresponded to it, Mr. A. D. Cotton of Kew very kindly examined the material and looked up the literature on the subject. He confirms my opinion that the species is a new one and places it near *Pleospora muscicola* Cke. & Mass. found on *Bryum pendulum* at Dumb-bell Bay, 82° N. The spore-measurements of this species as given in Grevillea XVII., p. 76 (1889), are not quite correct. The original material in the Kew Herbarium shows that the spores are 18-20 $\times$ 8-9μ, blunt at both ends and decidedly constricted. The new species differs from it in the paler, more pointed and non-constricted spores, as well as in other minor characters. The diagnosis is as under.

PLEOSPORA HEPATICOLA n. sp.

Peritheciis sphaeroideis, haud 0·5 mm. latis, breve papillatis, nigris, subnitidis; ascis clavatis, octosporis, manifeste stipitatis; sporidiis distichis, ellipsoideis, medio non constrictis, uno apice acutis, 5-7 septato-muralibus, primo sine colore, postea fuligineis, 20-28 $\times$ 8-9μ; mucilaginibus iodo rubescentibus.

Ad folia *Lophocoleae heterophyllae.* Dittisham, Devon, Febr., 1914.

A NEW VARIETY OF SEPEDONIUM MUCORINUM HARZ.

SEPEDONIUM MUCORINUM HARZ. VAR. BOTRYOIDES.

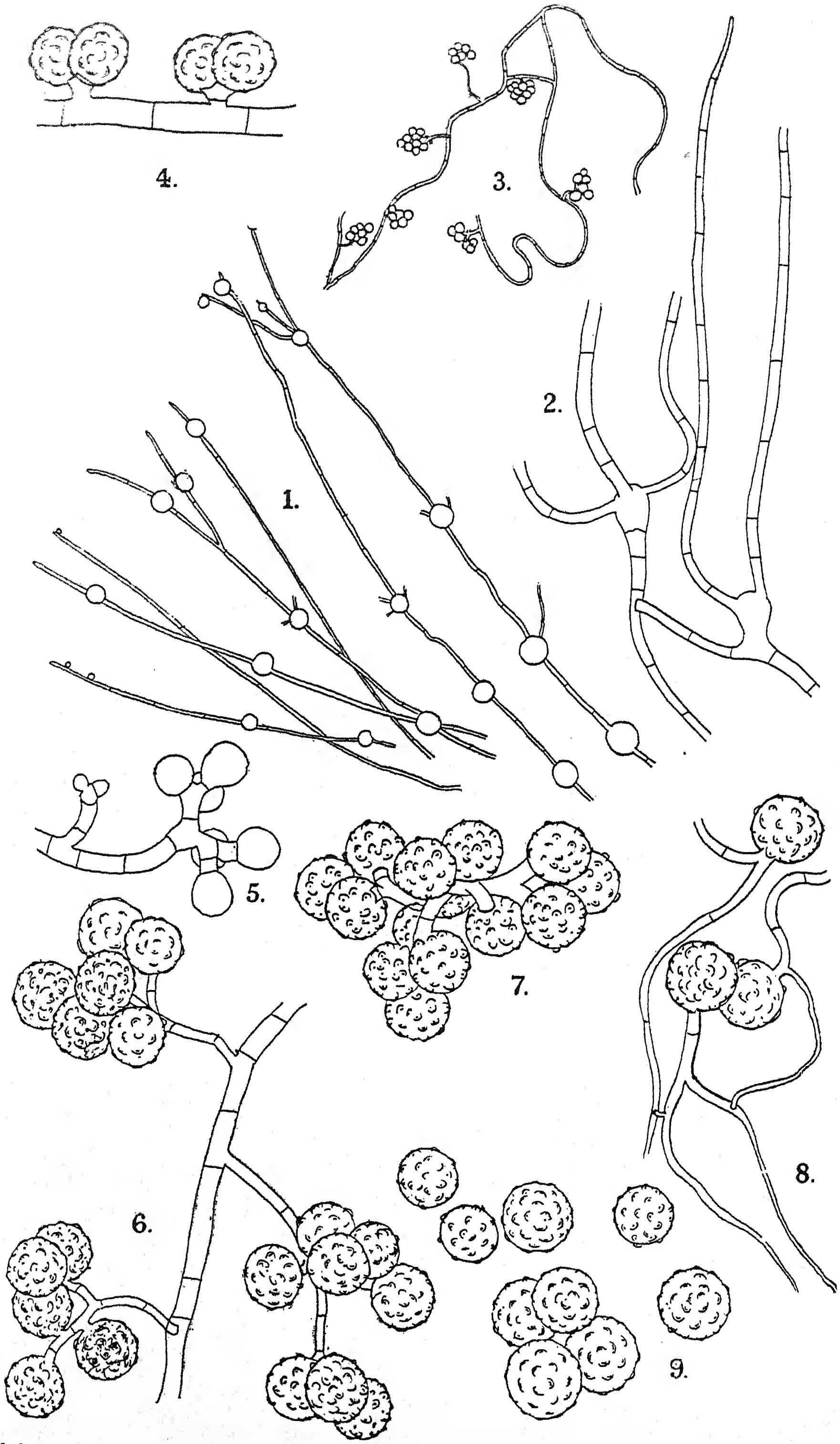
By Jessie S. Bayliss Elliott, D.Sc. Birm., B.Sc. Lond.

This fungus which seems to agree in many details with *Sepedonium mucorinum* Harz, recorded for Germany and Austria where it was found growing on various Mucors, has recently appeared in the Botanical laboratory of Birmingham University, on soil cultures containing decomposing earthworms or sticklebacks.

The fungus can very easily be cultivated on a special preparation of gelatine; here it forms a dense mycelium, pale buff in colour, granular in appearance because of the masses of conidia produced, and zoning is always very well marked. In a petri-dish culture the growing margin looks silky and the radiating hyphae when examined with a low power lens, appear to be studded over with rounded drops (Fig. 1). These drops are really large swellings in the hyphae where branches arise (Fig 2). H connections between hyphae, even between germ tubes are frequent (Figs. 2, 3, 8).

The conidia occur in great quantities and are very large, 13-17μ in diam., colourless and at first smooth (Fig. 5) but later evenly warted (Fig. 9). These are never deeper in *colour* than pale buff although Harz describes those of *Sepedonium mucorinum* as "hyaline then rosy or somewhat brownish." The conidiophores are of varying lengths and are usually branched (Fig. 7) rarely short and simple as described by Harz for *S. mucorinum.* The conidia germinate very easily, within twenty-four hours producing septate germ tubes which often anastomose with one another (Fig. 8), and in hanging-drop cultures after three or four days an abundant mycelium of branching and anastomosing hyphae copiously covered with conidiophores (Fig. 3). This fungus has never been seen growing on the Mucors, which frequently appeared in the soil-cultures in which it was found, although the habitat of *Sepedonium mucorinum* Harz is described as "on various Mucors."

Since this species differs from *S. mucorinum* only in the aforementioned details, it seems advisable to consider it merely a variety having instead of simple short conidiophores, long con-



J. S. B. E. del. West, Newman proc.

SEPEDONIUM MUCORINUM *Harz.* var. BOTRYOIDES *Bayliss Elliott.*

idiophores branched at the apex with the conidia appearing in clusters of nine or more, hence the name *S. mucorinum* var. *botryoides.*

Sepedonium mucorinum Harz.

Mycelium delicate, branched, hair-like, creeping; fertile hyphae simple, short, ascending; conidia solitary or in threes, globose, at first smooth, then evenly muriculate, hyaline, then rosy or somewhat brownish, 17-18μ in diameter, on various Mucors, Germany, Austria.

Sepedonium mucorinum Harz, var. *botryoides.*

Mycelium delicate, branched, hair-like, creeping; conidiophores ascending, long, branched near the apex, rarely simple; conidia in clusters of nine or more, arranged in threes at the end of each branchlet, rarely solitary, globose, at first smooth, then evenly warted, hyaline then pale buff, 13-17μ.

In soil containing decaying animal matter.

Mycelio tenero, ramoso, capillaceo, decumbente, conidiophoris adscendentibus, longis, apicem versus ramosis, raro simplicibus, conidiis nonis vel pluribus agglomeratis, ternis in ramulis, terminalibus digestis, raro solitariis, globosis, primo levibus dein aequaliter verrucosis, hyalinis, deinde subochraceis.

In terra pingui.

EXPLANATION OF PLATE 7.

Fig. 1.—Growing margin of a culture showing round swellings, x 93.

Fig. 2.—Small swellings, x 504.

Fig. 3.—Fertile hyphae showing clusters of conidia and anastomosing hyphae, x 93.

Fig. 4.—Conidia from a nearly exhausted culture, x 800.

Fig. 5.—Young conidiophores and young smooth conidia, x 800.

Fig. 6.—Older conidiophores and conidia with very rough surface, x 800.

Fig. 7.—Large clusters of conidia, x 800.

Fig. 8.—Germinating conidia showing anastomosing germ tubes, x 800.

Fig. 9.—Mature conidia, x 800.

ON THE PRODUCTION OF IMPERFECTLY DEVELOPED SPORES IN THE AGARICACEAE.

By A. D. Cotton, F.L.S.

In practically all groups of Fungi except the Hymenomycetes, the size and shape of the spore is an important item in the diagnosis of the species. In the Hymenomycetes, however, specially in the Agaricaceae, the spore has never been given a prominent place. This is no doubt largely due to the fact that most species possess good field characters, and being in the main macroscopic plants, resource to the microscope is unnecessary. But there is an idea prevalent (which to a certain extent is supported by the literature) that the spores vary more in this group than in others, and, that for this reason, they are almost useless for systematic purposes. It is true that in certain genera they are of little value (for the reason that they are practically uniform in all the species), but in others they afford a most useful supplementary character, and there is no evidence whatever to show that these bodies, so valuable in other groups of fungi, are less constant in the Agaricaceae.

The ordinary precautions necessary when examining external morphological characters are just as needful when microscopic features are in question. As pointed out on p. 231, care must be exercised to select good average spores, and also those that have reached maturity. In addition, it is important to remember the possible existence of characteristic variability, i.e., that variability may be a feature characteristic of the species in question.

The presence of ill-nourished spores was also alluded to. It appears unlikely that such spores are frequent in nature, but under certain artificial conditions, a whole crop may be produced which if not recognised as abnormal would convey a totally wrong impression. Since no account of spores of this type has, as far as I know, been published, the following details may be of interest.

The point came to light last season during an examination of Falkland Island material of *Stropharia semiglobata*. The question was raised as to whether the first shed spores from a given pileus differed at all from those which were liberated later. To determine this a succession of spore-casts was prepared from English specimens. Vigorous young sporophores of *S. semiglobata* were used, and the pilei set on white paper in the ordin-

ary way, covered with small glasses, and shifted every hour to a fresh position. The experiments were carried out in the Kew Herbarium and during the summer months, that is, in a fairly dry warm atmosphere. The spores fell copiously during the first day, and also during the night. By the morning the pilei were somewhat shrivelled, but a series of spore-casts was obtained during the second day, shifting being done in this case about every two hours. During the second night spores continued to fall, but by the morning the majority of the pilei had dried up too much to be of further use. Microscopic examination of the spores gave a rather startling result. Whilst those of the first day measured 18-20 × 9-10μ and were a deep purple black, those deposited on the morning of the third day were not more than two-thirds of the original size and much paler in colour. The intervening spore-casts showed a gradual diminution in size, though this was not noticeable during the first few hours. The figures for one example were as under, the average measurement, as nearly as possible, of the spores being calculated.

1st hour	18 × 10μ	36th hour	14 × 8μ
13th hour ...	16 × 9μ	48th hour	13 × 8μ
23rd hour	15 × 9μ	83rd hour	12 × 7μ

This experiment was repeated several times, and always gave similar results though the reduction in spore-size was not quite so great in most cases. Other species were tried, but as none had such large spores the results were not so striking, nor did the plants in all cases behave in quite the same way.

At first these observations seemed to show that the last shed spores differed decidedly from the earliest and to afford an explanation of the discrepancies in handbooks, and even to provide an argument against their use. But further examination proved that the results obtained were artificial, and that in practice the danger is more apparent than real. It was found that when plants of *S. semiglobata* grown under natural conditions were examined, old specimens showed spores that were of normal size, and in no case was there a crop of small spores. The explanation lies doubtless in the fact, that in the first case the pilei were separated from the stalk, and the experiments performed in a dry warm atmosphere; under these conditions spores continue to develop for two or three days, but are poorly nourished, and fall off without reaching the normal size. This conclusion was confirmed by the following little experiment.

Whole sporophores (pileus, stalk, and base) were collected and placed upright in large test tubes, supplied with a little water and stood out of doors in a damp shady position. In order to obtain spore-casts, each sporophore had a paper collar fixed beneath the gills. The plant could easily be taken out of the tubes by means of curved forceps, and the collars, which were changed daily, were

placed in position and removed by means of a lateral slit. Under the conditions of this experiment spores continued to fall for several days, usually five or six, occasionally eight, or even nine. An examination of the collars showed practically no difference in the size of the spores. After the fifth or sixth day the spores were few and slightly paler in colour, but the majority reached the normal dimensions, though several fell short.

These observations, together with the examination of many old specimens, justify us in saying that the spores formed on the gill of *S. semiglobata* are practically uniform in size throughout the whole life of the plant. As there is no evidence which leads us to expect that this species differs from other Agarics, we may fairly infer that the above conclusion holds good generally, and that, as long as mature spores are examined, the exact age of the specimen is not of great importance. No conditions comparable with the severance of the pileus from the stipe occur in nature (very rapid desiccation being perhaps the nearest to it), hence, though a few ill grown spores will be found on almost every naturally grown specimen, the production of a crop of such spores is probably unknown.

SOME NOTES ON THE GENERA OF THE THELEPHORACEAE.

By E. M. Wakefield, F.L.S.

Historical Sketch.

Some of the more conspicuous species of the group of Basidiomycetes known as Thelephoraceae were among the earliest fungi to be studied. Micheli in 1729 describes and figures a Stereum-like plant, which has been referred to *Hymenochaete rubiginosa*, and also several resupinate species, one of which (" Agaricum lichenis facie, caeruleum ") was in all probability *Corticium caeruleum*.

Scattered descriptions of species occur in subsequent works, and the name Thelephora, attributed by Fries to Ehrhardt, who distributed *Thelephora terrestris* in his " Plantae Cryptogamae Exsiccatae," No. 178, appears to have been first defined by Willdenow (1787) as " Fungus inferne papillas loco foraminum vel lamellarum proferens." Willdenow included under this name three species, one of which is *hirsuta* (now Stereum), and the others apparently true Thelephoras. Willdenow listed eighteen genera, beginning with the larger pileate forms, and ending with forms with closed fruit bodies, as Lycoperdon, Sphaeria, Mucor, etc. The first attempt to arrange the fungi in a system expressing their natural affinities, however, was made by Persoon in his " Tentamen Dispositionis Methodicae Fungorum " (1797). Here the genera Stereum and Corticium (established by him in 1796 on the basis of habit) appear with Tremella in a section of his order " Hymenothecium," characterised by a fleshy receptacle bearing the " thecae " (spore-bearing organs) superficially, and including therefore besides Hymenomycetes as at present defined, Discomycetes, Puccinia, and some Hyphomycetes.

In his more important " Synopsis " (1801) he included in the section " Gymnodermata " of Hymenothecii the genera Thelephora and Merisma, and united Tremella with the Discomycetes. Merisma was a form-genus established for branched or encrusting forms—as *Thelephora penicillata*. The genus Thelephora was here subdivided into Craterella, Stereum, and Corticium, according to habit, and the names therefore are not used in the same sense as they were afterwards used by Fries. Craterella was used for stipitate forms Stereum for dimidiate

forms, including species of Thelephora, Stereum, and Hymenochaete, while Corticium comprised resupinate forms.

It is interesting to note that as early as 1796 Persoon observed the arrangement of the spores in fours in "*Corticium caesium*," where they are very conspicuous on account of their dark colour against the greyish tissue. He remarks with regard to this species—"Sporae in hac specei eleganter quaternatim dispositae, uti hoc in nonnullis Agaricis fimetariis obtinet." The meaning of this arrangement, however, was very far from being understood. At that time it was thought that the spores of all these genera were developed in "thecae" (or asci), and Link and Nees give figures of these thecae in species of Coprinus and Thelephora, from which it is evident that they supposed the "quaternary" arrangement of the spores to be due to the occurrence of the thecae in groups of four. It was not until 1837 that the true significance of the arrangement was understood.

In 1809 Link adopted the genera Thelephora, Stereum, and Merisma, rejecting Persoon's Corticium on the ground that the resupinate habit was not sufficient distinction, and that many species of Corticium might be the early stages of other fungi. His Stereum, curiously, is confined to species with setulose hymenium (now Hymenochaete), but his explanation of the setae as the projecting apices of the thecae was due to the prevailing error as to the nature of the hymenium.

In the first volume of his "Systema Mycologicum" (1821) Fries constituted the class Hymenomycetes for genera with "hymenium nudum," including in it Discomycetes as well as Hymenomycetes proper. Under the group "Pileati" he adopted the name Thelephora for all species hitherto known, using as subgenera only the names Stereum (in the sense of Link), Phylacteria (for resupinate species with coloured spores arranged in fours), Himantia, and Leiostroma (based on texture).

In the "Systema Orbis Vegetabilis" (1825) Fries distinguished under Pileati the group Auricularini, to include Thelephora, Auricularia, Phlebia, Coniophora (established by De Candolle for *C. membranacea*, with a powdery layer of brownish spores) and Stereum (of Link). The genus Thelephora is here used for species having *dark* spores arranged in groups of four, while Coniophora is defined practically as at present, with ochraceous or subferruginous spores. Fries seems to have had great difficulty in arriving at any clear conception of the group, since he changed his definitions so many times. He himself described the old genus Thelephora as an "Augean stable," into which all kinds of "offscourings" were liable to be thrown.

In his "Genera Hymenomycetum" (1836) he again took up the genera Stereum and Corticium in addition to Thelephora, and also included Hypochnus and Kneiffia in the Auricularini. The names Stereum and Corticium, however, are here not used in quite the same sense as by Persoon and Link. Stereum includes species with both velvety and smooth hymenium, and is characterised by the hymenial surface being coriaceous, and remaining unchanged when dry, whereas that of Corticium is said to be soft and waxy when fresh, becoming cracked when dry.

The work of Léveillé and Berkeley resulted in the understanding of the true nature of the hymenium in the Basidiomycetes, and paved the way for a more natural classification. Léveillé in 1837 divided the old group Hymenothecii of Persoon, or Hymenomycetes of Fries, into Basidiospori or Hymenomycetes proper, and Thecospori (Ascomycetes). Léveillé was also the first to understand the true nature of the setae in certain species of Stereum, which he separated off as the genus Hymenochaete. His conception of the genus, according to the list given, included species with both hyaline and coloured setae and cystidia, and Berkeley seems to have been the first to restrict the name to its present use, namely for those species with coloured setae only.

After Tulasne had shown in 1853 the very different structure of the hymenium in the Tremellineae and Dacryomyceteae, these were removed from the neighbourhood of the Thelephoreae, but Auricularia was included in the group until the time of Brefeld (1888), although de Bary showed in 1866 that the basidia of this genus are transversely septate, and Tulasne in 1872 suggested that it formed a third type in the Tremellini.

In Fries' "Hymenomycetes Europaei" (1874), besides Auricularia, the genera Craterellus, Thelephora, Stereum, Corticium, and Cyphella were included in the group Thelephorei. Corticium was defined as in the "Genera Hymenomycetum," with Hypochnus and Coniophora as subgenera, and Stereum was distinguished from Thelephora by the possession of a distinct intermediate fibrillose layer. Léveillé's genus Hymenochaete was rejected and the species included under Stereum. Cooke, however, reinstated the genus, and in 1878 constituted the genus Peniophora for species previously included under Corticium, which possess a certain type of hyaline cystidium, to which he gave the name of "metuloid." Cooke's genus is a very useful one, and has been very generally adopted. Recently, however, its meaning has been extended to include forms with very different cystidia and different habit from the species known to Cooke, with the result that the genus appears somewhat artificial.

An advance in the study of the Thelephoreae was made by Massee in his Monograph (1888-90), where he adopted the characters of spores and cystidia as his chief distinguishing features. More recent investigations have confirmed the importance of microscopic characters in this group, and the greater attention paid to such characters of late years has resulted in considerable modifications as to species and genera.

The group as defined in Saccardo's Sylloge, Vol. VI., is scarcely a natural one, as was pointed out by Mr. Cotton.* Other systems have been proposed, but none has been generally adopted. Patouillard in 1887 divided the Thelephoreae primarily according to the colour of the spores, but still kept the group as a whole intact, though he departed from the usual custom in his usage of some of the generic names. In his "Essai Taxonomique" (1900), however, besides the separation of Exobasidium and Cyphella and its allies the genera Phylacteria (= Thelephora auctt.) and Tomentella are widely separated and placed with the Hydneae, while Hymenochaete is united with the section Igniarius of Fomes, in which similar setae occur. Quélet also included Thelephora and Kneiffia with the Hydneae.

Maire in 1902 divided his Autobasidiomycetes (Homobasidii) into two groups—(1) Protohymenii, with the single species *Vuilleminia comedens* (= *Corticium comedens* Fr.) characterised by possessing an "irregular" hymenium with very large basidia, analogous to the hymenium of the Tremellineae, instead of a "regular" close hymenium as in other Autobasidiomycetes; (2) Euhymenii, with four orders—Cantharellineae, Polyporineae, Agaricineae, and Lycoperdineae. With regard to resupinate genera Peniophoraceae (including Stereum) and Phylacteriaceae (Thelephora) are given as sections of Cantharellineae, while Corticium, Hypochnus, and Kneiffia form the section Corticieae of Polyporineae.

None of these systems is satisfactory, since the undue emphasis given to one character or set of characters tends to separate genera that in other respects appear to be closely allied. It is impossible to make a wide distinction between Peniophora and Corticium, since all transitional forms occur, and some species of Peniophora, as *P. incarnata*, may sometimes occur without a trace of the characteristic Peniophora cystidia. Similarly it appears unnatural to separate Hymenochaete widely from Stereum, or both from the neighbourhood of Peniophora. Species of Stereum (now often separated as a genus Lloydella) occur with hyaline cystidia like those of *Peniophora* and Peniophoras such as *P. laevigata* with brownish cystidia connect Peniophora with Stereum and Hymenochaete.

* Trans. Brit. Mycol. Soc. 1911, p. 337.

RECENT WORK.

Until our knowledge of the species included in the group is more complete, it is doubtful whether any more satisfactory system of arrangement can be devised. The most valuable of the more recent work has been in the direction of separating out a number of heterogeneous species and genera formerly included, especially under Corticium, a genus which perhaps even now may well answer to Fries' description of Thelephora, since it is little more than a dumping-ground for species that cannot be included elsewhere.

As far back as 1872 Tulasne pointed out that *Corticium incrustans* Pers. (= *Thelephora sebacea* Pers.) has septate basidia, somewhat like those of Tremella, and made it the type of a new genus Sebacina, allied to the Thelephoreae in habit and to the Tremellineae in the structure of its basidia. He was in error, however, in attributing *Thelephora caesia* to the same genus. Closely allied to Sebacina is a plant described by Bresadola as *Eichleriella Kmetii* (which is the same as *Radulum deglubens* B.).* It is a somewhat uncommon plant in Britain, and as far as I have been able to ascertain has been the basis of British records of *Stereum rufum*. The true *S. rufum* Fr. is a very different plant. *E. Kmetii* was also determined by Berkeley as *C. confluens* Fr., a fact which was the origin of the very large spore-measurements given for that plant in Massee's "British Fungus-Flora."

Tulasne also described a plant, wrongly identified as *Corticium incarnatum (pinicola)*, which formed the type of the genus Tulasnella of Schroeter (= Pachysterigma Bref.; = Prototremella Pat.). This is a peculiar genus, of which several species have been described, having globose basidia approaching in form those of Tremella or Sebacina, but unseptate, and bearing four large swollen sterigmata which themselves resemble spores, and were so regarded by Juel (1897). The genus is sometimes included in Thelephoreae, and sometimes in a separate group more nearly related to the Tremellineae. It differs widely from all other Thelephoreae, but the species require further investigation. Species of Tulasnella certainly occur in Britain. I have twice received specimens which undoubtedly belonged to this genus, but in too poor a state for identification.

Another genus, species of which were formerly included under Corticium and Hypochnus, is that for which Patouillard in 1887 adopted the name Tomentella, which was applied by Persoon as a subgenus for the two species *C. ferrugineum* and *chalybaeum*. In the sense of Patouillard it includes

* *Cf.* Lloyd, Letter No. 45, Note 79, 1913.

resupinate Hymenomycetes with loosely woven hyphae and brown echinulate spores, and constitutes a very natural genus, related to Thelephora and also to certain Hydneae. By some mycologists, however, the meaning has been extended to include species with hyaline echinulate spores, which in other respects do not appear to be related to the true Tomentellas. Hypochnus as limited by Karsten is a synonym of Tomentella. Fries' Hypochnus, based only on the loose texture does not appear to be a good genus, some species being Tomentellas, and others (the hyaline-spored species) being not sufficiently marked off from Corticium.

Aleurodiscus was constituted by Rabenhorst in 1874 for *C. amorphum*, and is a well-marked genus of peculiar hymenial structure, sharply marked off from other Corticieae. and perhaps better included near Cyphella as Patouillard suggests. It has been studied by von Höhnel and Litschauer (1907).

Several other genera have been proposed from time to time, the value of which requires investigation. One which has recently come into very general use is the genus Gloeocystidium Karst., applied to species of Corticium having, more or less embedded in the tissues, special swollen structures of the nature of laticiferous hyphae, such as occur in Russula, etc. A corresponding genus, Gloeopeniophora has been proposed for species of Peniophora with similar structures. Such tissue however, is of such general occurrence among Basidiomycetes. that it is very doubtful if its presence in this group should be regarded as a generic character. The question as to the function of these structures and the nature of the cell-contents is one of the interesting problems which arise in connection with the Thelephoreae.

Other proposed generic names, the value of which is doubtful, are Coniophorella, Hypochnella, Dendrothele, Epithele, Asterostroma, Aldridgea, etc., based on the occurrence in the hymenium of outgrowths or cystidia of various forms, or on the consistency of the tissue. One confusing factor in the systematic study of these plants, which has not yet been fully recognised, is their tendency to polymorphism. This variability has been shown especially by Brinkmann (1909 and 1913) and by Bourdot and Galzin (1911-12). As an instance may be cited *Corticium lividum* Fr. (in Hyménomycètes de France of Bourdot and Galzin, 1911), which may occur in three forms, namely, (1) as a typical Corticium, (2) with an irregular hymenium simulating an Odontia, and (3) with a rugulose hymenium as in Phlebia (= *Phlebia livida* Bres.). The second form was determined by Berkeley (probably correctly) as *Grandinia ocellata* Fr. Similarly *Peniophora incarnata* when growing on Carpinus often assumes the habit of *Corticium*

comedens, and is then *Radulum laetum* Fr. The same species frequently occurs with no Peniophora cystidia, when it could quite well be placed in Corticium. The careful study of species in the living state will probably reveal many cases of this kind, and is the only hope of substituting a better understanding for the confusion that has hitherto reigned.

NEW AND RARE BRITISH FUNGI.

By Carleton Rea, B.C.L., M.A.

With Plates 8 and 9.

Lepiota helveola Bres. Fung. Triden. I, 15, t. XVI. f. 2 and see plate 8.

Pileus 1·5-3 cm. wide, fleshy, convex then expanded, somewhat umbonate, *scaly*, *madder-brown*. Stem 2-4 cm. long, 3-7 mm. thick, fistulose, equal, fibrilloso-tomentose, of the *same colour as the pileus;* ring distant, fugacious, whitish. Gills 4-5 mm. wide, free, crowded, creamy white, edge fimbriate, ventricose. Flesh white, becoming reddish when dry. Smell and taste none, poisonous. Spores white, hyaline, elliptical or subreniform, $6\text{-}10 \times 4\text{-}6\mu$.

Amongst short grass, Grange Park, Swarraton, Hampshire, 2nd October, 1913, C. R.

Easily known amongst the smaller species of Quélet's Squamosae section of *Lepiota* by the madder-brown squamules on the pileus.

Tricholoma irinum Fr. Hym. Eur. 72; Quél. Fl. Myc. 270 and see plate 8.

Pileus 5-12 cm. wide, convex then plane, obtuse, moist, glabrous, sometimes obscurely virgate, *pale flesh colour*, margin incurved, *pruinose* and white. Flesh tinted pale pink then white. Stem 6-12 cm. long, 2-3 cm. thick, solid, subbulbose, *striate*, paler in colour, pruinose and whitish at the apex. Gills narrow, 5-6 mm. wide, sinuato-adnate, crowded, pale ochre becoming somewhat lurid with age. Smell *very pleasant*, according to Quélet suggesting the scent of *Iris* or *Viola*. Spores

white, hyaline, dirty pink or yellowish in the mass, elliptical, $7\text{-}9 \times 4\text{-}5\mu$.

Amongst grass, Grange Park, Swarraton, Hampshire, 4th October, 1912, Rev. W. L. W. Eyre.

Quélet says that it resembles *Hebeloma crustuliniforme*.

Clitocybe virens (Scop.) Fr. Scop. Carn. 437; Fr. Hym. Eur. 85; Bull. Soc. Myc. Fr. V., 6. *Agaricus viridis* With. arr. 4, 198.

Pileus 3-6 cm. wide, fleshy, convex then expanded, obtuse, glabrous, pale greenish blue; margin smooth. Stem 3-8 cm. long, 3-7 mm. thick, solid, firm, cylindrical, attenuated at the base, glabrous, whitish. Gills 5-6 mm. wide, thin, crowded, adnato-decurrent, white. Flesh white. Smell and taste of anise. Spores white, elliptical, $7\text{-}8 \times 4\text{-}5\mu$, with a large central oil drop.

Roadside, near Mar Lodge, Aberdeenshire, 30th September, 1908, C. R.

Distinguished from *C. odora* by the greener colour of the pileus, the white cylindrical stem attenuated at the base and the white, crowded gills.

CLITOCYBE ALBOCINEREA Rea. See plate 8.

Pileus 2-3 cm. latus, e convexo-umbilicato expansus et cyathiformis, udus *cinereo-fuscus* dein expallens, sericeus, margine involuto. Stipes 5-6 cm. longus, 3-5 mm. crassus, aequalis, solidus, glaber, *albus*, basi albotomentoso. Lamellae 1-2 mm. latae, angustae, decurrentes, *albae*, confertae. Caro alba, *odore et sapore grato*. Sporae albae, hyalinae, ellipticae, minutae granulosae, $5\text{-}6 \times 4\mu$.

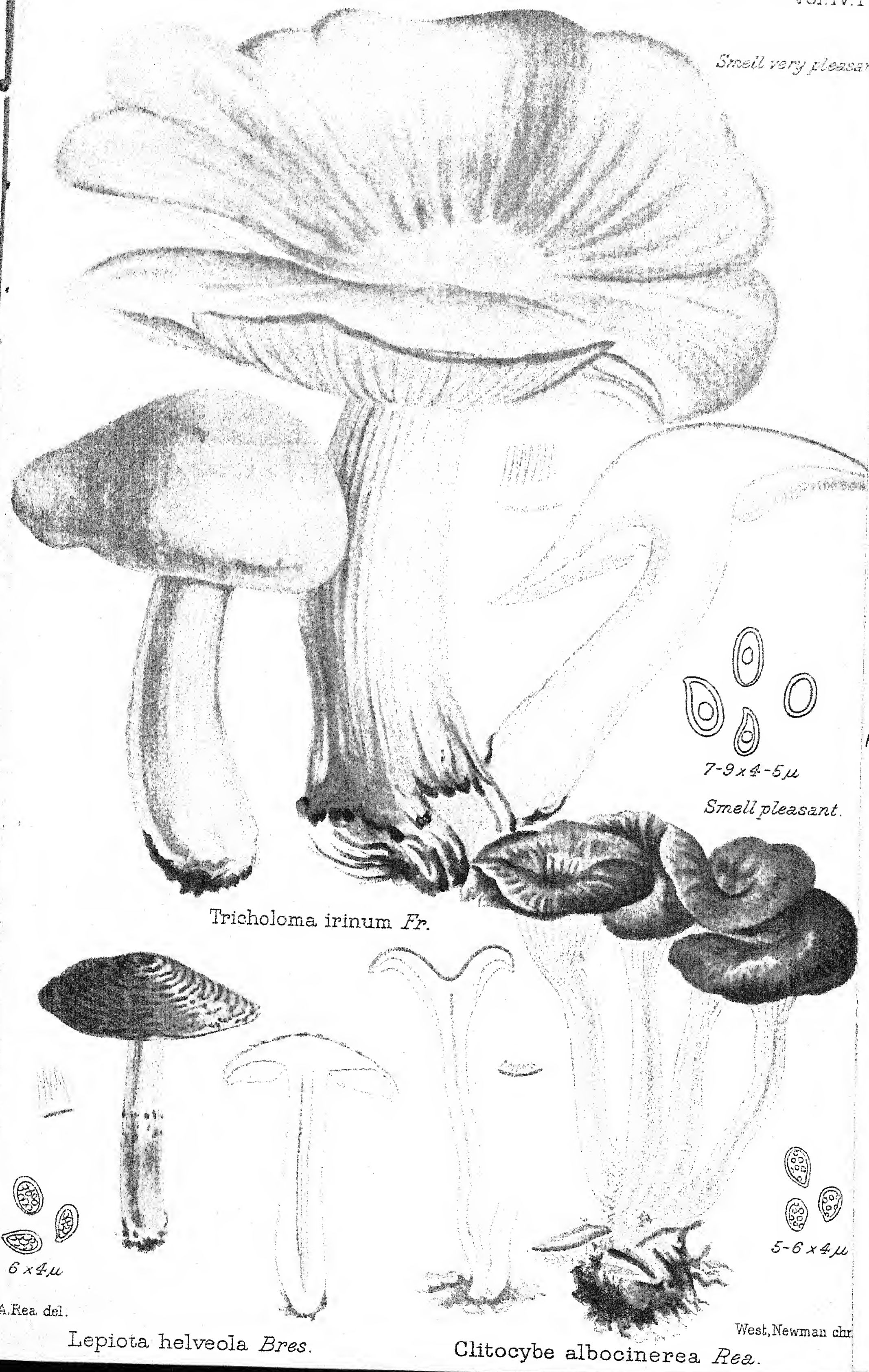
In pascuis prope Swarraton, Hants. Legit W. L. W. Eyre, 8-ix-1913.

Easily known amongst the species of the Cyathiformes group of *Clitocybe* by the pure white gills, white solid stem, small punctate spores and pleasant smell. It has since been collected by Mr. W. B. Allen in Shropshire and by myself in Wyre Forest, Worcestershire.

Laccaria nana Massee Kew Bull. No. 6 (1913) 195.

Pileus somewhat fleshy, 1 cm. wide, hemispherical becoming plane and concave, smooth, livid-cinnamon becoming paler, margin at first covered with white meal. Stem 1 cm. long, hollow, fibrillose, white. Gills rather distant, adnate, attenuated at the base, pale, at length white mealy. Spores globose, echinulate, hyaline, $15\text{-}16\mu$ in diam. Basidia clavate, sterigmata 2, $30\text{-}35 \times 7\text{-}8\mu$.

Scattered on naked soil under trees in Kew Gardens.



Tricholoma irinum *Fr.*

Lepiota helveola *Bres.*

Clitocybe albocinerea *Rea.*

"Distinguished from all known species by its small size, large spores and even, glabrous pileus."

Collybia luteifolia Gillet. Tab. Anal. Hymén. 66.

Readily distinguished from every other species of *Collybia* by the sulphur yellow gills and the reddish cap and stem.

On the ground, Kew Gardens, Kew. Bull. No. 6, (1913) 196.

Mycena Seynii Quél. Soc. bot. XXIII, 351, t. 2, f. 9; Fl. Myc. 219.

Pileus vinous, shining. Stem fistulose, hyaline, purplish, base hairy white. Gills rosy lilac.

On rotting leaves. Naturalist, Jan. (1913) 24.

Mycena chlorantha Fr. Hym. Eur. 134 (=*Mycena virens* (Bull.) Quél. Trans. Brit. Myc. Socy. III, 125. Pl. 7).

Mulgrave Woods. Among moss. Naturalist, June (1913) 173.

Mycena nivea Quél. Soc. bot. XXIII, t. 2, f. 1; Fl. Myc. 222.

Shining white. Pileus sulcate, diaphanous. Stem pruinose, base rather swollen, fibrillose. Gills uncinate.

Naturalist, Jan. (1913) 24.

Mycena simillima Karst. [Fragm. Myc. Fenn. XXXII.] Hedw. 30, 1891, p. 246.

Pileus conico-campanulate, even, dry, glabrous, livid or dingy pallid. Stem fragile, polished, even, glabrous, base curved, rooting. Gills emarginato-decurrent, crowded, white, very slightly tinged rose.

Very near to *Mycena galericulata*, but differing in being fragile and in becoming pale.

Mulgrave Woods. On tree stump. Naturalist, June (1913) 173.

Omphalia Kewense Massee. Kew. Bull. No. 6 (1913) 195.

Pileus somewhat fleshy, cylindrically-campanulate, 3-5 mm. high, very smooth, deeply sulcate, margin crenate, ochraceous becoming whitish. Stem 2-3 cm. long, thin, round, hollow, more or less flexuose, pale. Gills distant, membranaceous, subdecurrent, edge entire, pale. Spores ellipsoid, hyaline, $7 \times 5\mu$. Basidia subclavate, $28\text{-}32 \times 6\text{-}7\mu$.

Gregarious on dead rhizomes in the Filmy Fern House, Kew Gardens.

Remarkable for the deeply grooved, elongated, cylindric-campanulate pileus. Allied to *Omphalia picta* Fr.

Hygrophorus persicinus Beck. Zur Pilzflora Niederösterreichs IV. in Verhandl. der K. K. Zool.—Bot. Gesell, XXXVI. (1886) 470.

Pileus conical then hemispherical, edge incurved, peach colour or somewhat orange, shining, even. Stem constricted below the gills, pale lilac-peach-colour, base yellowish. Gills thick, both ends narrowed, decurrent, edge very obtuse, fuscescent. Spores $15\text{-}20 \times 5\text{-}6\mu$.

On the ground among short, scanty grass in woodland. Naturalist, Jan. (1913) 24.

Lactarius flavidus Boud. Bull. Soc. Myc. Fr. III, 145. t. XIII, fig. 1; Boud. Icon. Mycol. IV, 24, t. 48; and see plate 9.

Pileus 5-10 cm. wide, convex then expanded and slightly depressed at the centre which often remains umbonate, pale citron or sulphur yellow, obscurely zoned, firm, becoming stained with violet on injury or rubbing. Flesh white becoming quickly violet on exposure to the air. Stem 3-8 cm. long, 1-2 cm. thick, more or less attenuated at the base, solid, spongy in the middle, whitish or yellowish, soon stained with violet on handling or other injury. Gills narrow, 4-6 mm. broad, yellowish, bruising violet on injury, crowded. Milk white, quickly turning violet on exposure to the air, acrid. Spores white, ovoid, verrucose, reticulate, $9\text{-}10 \times 8\text{-}9\mu$.

On the ground under Oaks and Nut bushes, Hen Wood, Herriard, Hampshire, 30th September, 1913, C. R.

This species is easily distinguished from the darker coloured species *Lactarius uvidus* with somewhat similarly coloured milk by the *citron yellow colour* of all its parts which on the slightest injury or bruising give rise to a *deep purple stain.*

Panus farinaceus (Schum.) Fr. Hym. Eur. 490.

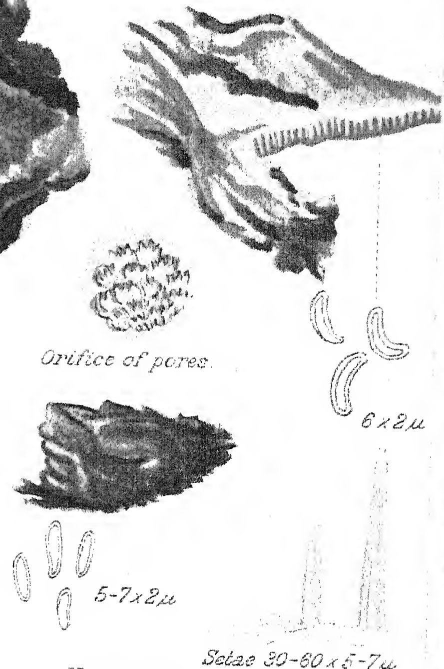
Pileus subcoriaceous, flexuous, 1·5-2 cm. wide, dusky cinnamon, *cuticle broken up into greyish-white scurf which falls away.* Stem lateral, short, concolorous. Gills free, *distinct*, pale.

Mulgrave Woods. On dead branch. Naturalist, June (1913) 173.

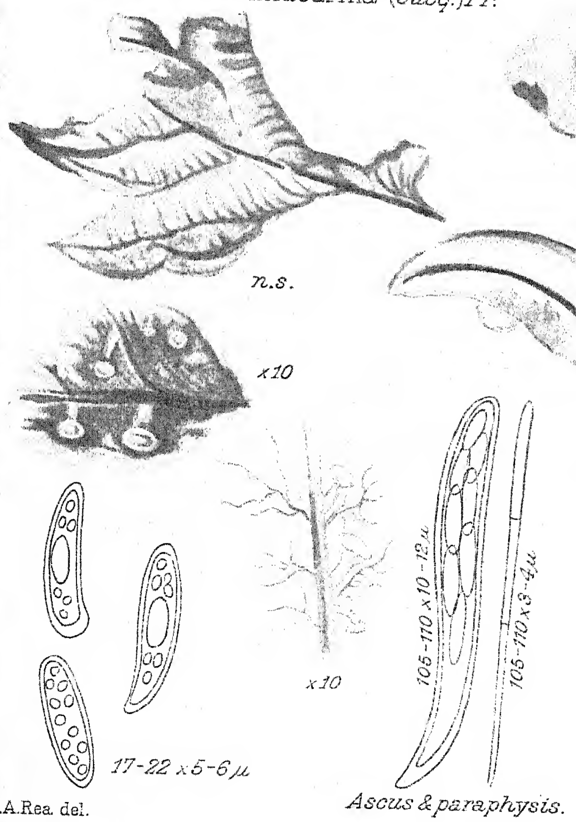
Inocybe violaceifolia Peck. 41 Rep. State Mus. 66.

Pileus convex or almost plane, fibrillose, squamulose, grey, 1-1·5 cm. Stem firm, solid, slender, fibrillose, whitish, 2·5 cm. long. Gills crowded, adnexed, pale violet then brownish cinnamon. Spores smooth, elliptical, $10 \times 6{\cdot}5\mu$. Cystidia ventricose, $50\text{-}60 \times 12\text{-}16\mu$, fairly numerous.

Trametes cinnabarina *(Jacq.) Fr.*



Hymenochaete Mougeotii *(Fr.) Ck.*



E. A. Rea. del.

Helotium sparsum *Boud.*

West, Newman

Lactarius flavidus *Boud.*

Distinguished among species having the gills tinged lilac by the whitish stem.

On the ground among moss. Naturalist, Jan. (1913) 24.

Naucoria amarescens Quél. As. fr. 1882; Jur. I, t. 7, f. 4; Fl. Myc. 87.

Pileus campanulate, 3-4 cm. wide, finely wrinkled, then excoriated and cracked, moist; *reddish brown*, then clay colour, margin slightly incurved. Flesh fissile, cream colour then reddish, tasteless becoming *very bitter*. Stem fistulose, white or ochraceous cream then *blackish bistre*. Gills emarginate, adnate, ventricose, ochraceous cream colour then brown. Spores pruniform, 9-11μ long, oblong, brown.

Luddenden Dean, near Halifax. Among grass. September 1912, Nat. Hist. Sec., Halifax Sci. Soc. Naturalist, June (1913) 174.

Psaliota Bernardii Quél. Fl. Myc. 73; Trans. Brit. Myc. Soc. III, 285. Pl. 14.

In pasture, Cullingworth, near Keithley, September, 1912. Naturalist, Jany. (1913) 24.

Stropharia depilata (Pers.) Fr. Hym. Eur. 283.

Pileus 3-12 cm. wide, compact, convex then plane, obtuse, smooth, glabrous, *viscid*, yellowish-livid then tan. Stem 4-15 cm. long, 5-13 mm. thick, white, solid, equal, *clothed with white, revolute, squarrose scales* below the large, distant ring. Flesh white. Gills 3-8 mm. wide, adnato-decurrent, at first white then becoming blackish. Spores brownish purple, elliptical, $7\text{-}8 \times 4\text{-}5\mu$.

Amongst straw refuse near a wheat rick, Swarraton, Hampshire, 17th November, 1913, Rev. W. L. W. Eyre.

Easily known among the Viscipelles group of *Stropharia* by the white, revolute, squarrose scales on the stem below the ring.

Dr. C. B. Plowright in Trans. Brit. Myc. Soc. I, 44, refers *S. Percevali* B. & Br. to this species, but there are so many points in which these two species differ that it seems impossible to assent to this.

Trametes cinnabarina (Jacq.) Fr. Syst. Myc. I, 371, sub *Polyporo;* Hym. Eur. 583; Quél. Fl. Myc. 395 and see plate 9.

Pileus dimidiate, 3-4 cm. across, 5-9 cm. wide, *bright reddish orange* becoming darker with age, slightly pubescent at first then glabrous, corky, rugulose, indistinctly zoned towards the margin. Pores 1-3 mm. long, orifice minute, round, pubescent, *deep blood red.* Flesh 1-2 cm. thick, pliant, *red.* Spores white, oblong, curved, $6 \times 2\mu$.

On a fallen Birch trunk, Murthly, Perthshire, 13th July, 1913, Mr. Charles McIntosh.

Easily known, among the *Trametes* having coloured flesh, by the vermilion orifices of the pores.

Trametes sinuosa (Fr.) Quél. Fr. Syst. Myc. I, 381; Ic. t. 190, f. 1; Hym. Eur. 576; Quél. Jura 346, sub *Polyporo;* Quél. Fl. Myc. 371 and see plate 10.

Resupinate, broadly effused, from 3-6 cm. and more, pure white becoming yellowish with age, furnished with *long, white, stringlike, mycelial rhizoids* on the underside. Pores 2-3 mm. long, orifice large, *flexuose, irregularly torn*, often *daedaliform* or *sistotremiform, pruinose.* Smell *very pleasant* like Liquorice according to Fries and Balsam according to Quélet. Spores white, elliptical, 5-6 x 3-4μ, with a large central gutta.

Attached to Ivy trailing on the ground in a shrubbery at Henley-on-Thames, Oxfordshire, 29th October, 1913, Mr. F. T. Brooks.

Characterized by the very irregular, intricate mouths of the pores, the mycelial rhizoids on the underside, and the very sweet smell.

Hydnum fuscoatrum Fr. Syst. Myc. I, 416; Hym. Eur. 612.

Subiculum widely effused, *forming a thin crust*, at first glaucous and flocculoso-pruinose, then becoming glabrous and ferruginous fuscous. Spines *short*, 1-2 mm. long, *conicosubulate, acute*, fawn colour becoming blackish. Spores white, hyaline, punctate, round, 4-4·5μ in diam.

On dead Birch trunks, Swarraton, Hampshire, 1st March, 1913, Rev. W. L. W. Eyre.

Coniophora Bourdotii Bres. in Ann. Myc. VI (1908) 45.

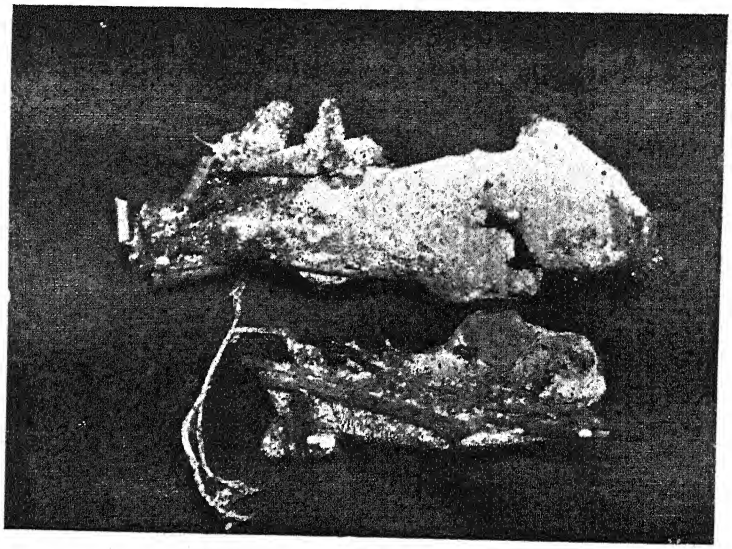
Forming rather large, smooth patches on bark. Hymenium umber, margin broad, white, delicately fimbriate.

Readily recognised by the large, brown, navicular or subfusiform spores, 17-23 x 6-9μ. These measurements taken from the Haslemere specimen, are slightly larger than those given in the original description. Possibly the same as *C. fusispora* (Cke. & Ellis) Cke.

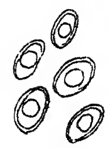
Miss E. M. Wakefield kindly determined the specimen and furnished me with the above description.

Hymenochaete Mougeotii (Fr.) Cke. Fr. Hym. Eur. 654 sub *Corticio;* Quél. Fl. Myc. 16, sub *Stereo;* Cke. in Grevillea VIII, (1880) 147; and see plate 9.

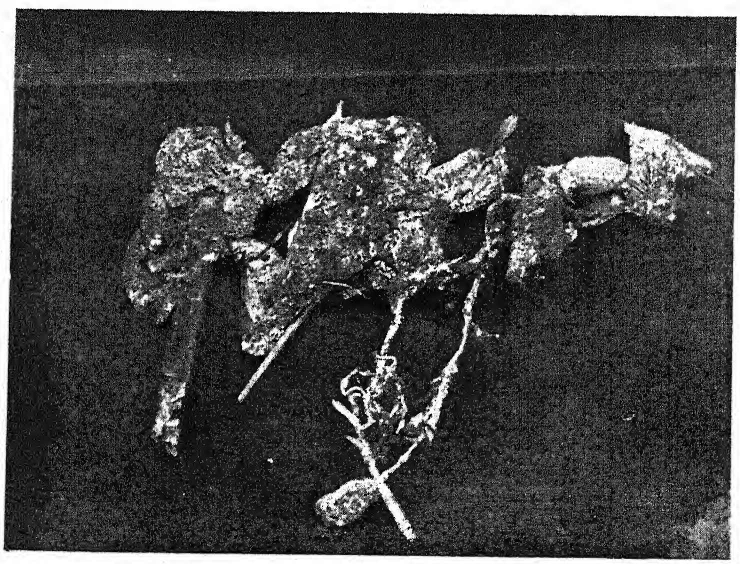
Waxy then rigid. Pileus effuso-reflexed, *rusty brown*, finely tomentose, silky and reddish-brown at the margin. Hymenium



Upper side.



5–6 × 3–4 μ



Under side.

Photogr. F. T. Brooks. West, Newman proc.

TRAMETES SINUOSA (*Fr.*) *Quél.*

tubercular or granular, pruinosely pubescent, *deep red*, velvety with *red setae* 30-60μ long, by 5-8μ wide at the base, apex hyaline and white. Spores white, cylindrically-ellipsoid 5-7 $\times$ 2μ.

On a dead branch of *Picea excelsa*, Felbrigg Woods, near Cromer, Norfolk, 24th August, 1913, Miss Violet Rea.

Easily known amongst the British species of *Hymenochaete* by the deep red colour of the hymenium and the red setae with hyaline tips. I am much indebted to Miss E. M. Wakefield for kind assistance in determining this species.

Peniophora longispora (Pat.) v. Höhn. *Kneiffia* Bres. Fungi Polon. 105. Bull. Soc. Myc. Fr. XXVIII (1912) 392.

A very marked species with the habit of a *Hypochnus* and differing from all other Peniophoras in its long, very slender spores, 12-17 $\times$ 2-2·5μ.

Kew. Bull. No. 6, (1913) 197.

Tomentella ferruginea Schroet. Crypt. Flo. v. Schles. I, 419.

Effused, thin, loosely felted, deep rust-brown. Basal hyphae creeping, dark brown with a purple tinge, 5-8μ wide, septa with clamp connections; basidia and subhymenial hyphae yellow-brown, basidia 10μ wide, sterigmata 4, curved, 8-9μ long $\times$ 1·5-2μ at base; spores bright yellow-brown, globose, 8-10μ diam. with numerous hyaline spines.

Mulgrave Woods. On decaying wood, bark, &c. Naturalist, June (1913) 174.

Ustilago Vaillantii Tul. Mém. s.l. Ustil. 90. t. III, fig. 15-19 in Annales d. sc. nat. III. Sér. 7. Bd.

Spores variable in form and size, roundish, angular or elongate, 7-12μ in diam., and up to 16μ in length, bright yellowish brown, transparent, papillate. In the anthers and ovaries of *Gagea lutea*, *Scilla bifolia* and *Muscari comosum*.

In the anthers of *Chionodoxa sardensis*, growing in the garden at St. Audrey's, Priory Road, Malvern, 3rd April, 1913. Mr. Norman G. Hadden.

Cordyceps myrmecophila Cesati. In Kl. Herb. Myc. 1033, et in Comm. Critt. It. I, 61, t. IV, f. 2; Nyl. Obs. Pez. 88, t. II, f. 4 Sacc. Syll. II, 566 (1883); *Torrubia myrmecophila* (Ces.) Tul. Carp. III, 19.

"Stroma solitary; the portion of the club bearing perithecia, ovoid, 1·3 mm. long, 0·7 mm. thick, stem filiform, ochraceous white, almost 2 cm. long, 0·2 mm. thick. Asci cylindrical, vermiform, 300 $\times$ 6-7μ; spores filiform, as long as the ascus, soon breaking up into numerous fusiform, or fusiform-cylindrical,

uncoloured joints, 7-11 × 1-2μ. Paraphyses none. Hab. On dead bodies of *Myrmica (Formica) rufa*, more rarely on Ichneumon and Coleoptera, in Italy, Finland, Britain, North America, Ceylon, Sarawak Borneo."

I am much indebted to Mr. J. Ramsbottom for kindly supplying me with the above definition of this species from Saccardo. The meagre description of this species set out in Cooke's Handbook II, 771. under *Torrubia myrmecophila* Tul. merely incorporates the diagnosis given by Berkeley and Broome in Ann. Nat. Hist. no. 591, founded on a single specimen collected at Leigh Wood, Bristol. The description is quite inadequate and would enable no one to reidentify this species. Mr. Ramsbottom informs me that there is a specimen in the Phillips Herbarium labelled *Torrubia myrmecophila* Tul., Trefoin, North Wales, May, 1874. Two specimens of this somewhat rare species were found at our Spring Foray in the Torrent Walk at Dolgelley on the 10th May, 1913, on a dead Dipteron. These agree well with the above description; Asci cylindrical slightly tapering towards the base, 260-300 × 5-6μ, spores filiform, 250-260 × 2μ, oozing out in long curved tendrils from the mouths of the perithecia and soon breaking up into twenty fusiform sporidia, 11-12 × 2μ each.

Melanospora Zobelii (Cda.) Fckl. Symbolae 127; *Ceratostoma Zobelii* Berk. Outl. 402; Cke's Handb. II, 926.

Perithecia gregarious, superficial, globose, transparent, yellowish, 260-360μ in diam., ostiolum short, papillate, fringed at the apex; asci broad, sessile, 8-spored, 50-60 × 28-35μ. Spores clustered, elliptical, somewhat pointed at both ends, unequal-sided, brown 25-30 × 12-15μ.

On the hymenium of *Sepultaria arenicola* (Lév.) Mass. Wallasey Sandhills, 25th November, 1913, Dr. J. W. Ellis.

Morchella rotunda (Pers.) Boud. Pers. Syn. 619; Fr. Syst. Myc. II, 7; Boud. Mor. Fr. Bull. Soc. Myc. XIII, (1897), 135; Icon. Myc. IV. 100, t. 195.

Pileus ovate, or oblong, rarely slightly conical, adnate to the stem, very variable in colour but generally ochraceous yellow; primary ribs slightly sinuous, inclosing large, irregularly rounded, flexuose pits, wrinkled in the interior. Stem slightly furfuraceous, paler, thickened and grooved at the base. Paraphyses thick, septate, branched, generally shorter than the asci, scarcely thickened at the apex. Asci hyaline, 8-spored, cylindrical, attenuated at the base, 350-400 × 20-22μ. Spores bright ochraceous in the mass, elliptical, 20-23 × 12-13μ.

On the ground, Mr. Stretton's Garden, Sansome Street, Worcester, 6th May, 1905.

Characterized by the broad alveolar pits and bright yellowish spores when deposited in the mass.

var. *cinerea* Boud.

Pileus greyish, stem whitish.

Near Cork, 14th April, 1906.

Morchella vulgaris (Pers.) Boud. Pers. Syn. 619; Boud. Mor. Fr. Bull. Soc. Myc. XIII. (1897), 139; Icon. Myc. IV. 104, t. 202.

Pileus oval or oblong, very rarely round, blackish or greyish black, rarely ash coloured or whitish, adnate to the stem. Pits very irregular, often anastomosing and becoming crowded and cerebriform, primary ribs thick, paler, often ferruginous in colour becoming confluent and projecting into the pits. Stem whitish ochre becoming paler when dry, glabrous or very slightly furfuraceous, swollen and sulcate at the base. Paraphyses fuliginous, septate, not or slightly thickened at the paler apex. Asci cylindrical, 8-spored, often immature, $300\text{-}350 \times 15\text{-}20\mu$. Spores elliptical, ochraceous in the mass, $18\text{-}20 \times 10\text{-}12\mu$.

On the ground, Mr. Walter Wood's garden, Infirmary Walk, Worcester, 27th April, 1907.

Characterized by the fuliginous paraphyses, the dark colour of the pileus and the very irregular, elongated, aveolar pits with transverse ribs.

Morchella hortensis Boud. Mor. Fr. Bull. Soc. Myc. XIII, (1897), 145; Icon. Myc. IV., 105, pl. 204.

Pileus oval, brown, adnate to the stem and having a slight groove near the stem which is occasionally imperceptible, longitudinal ribs simple or divided, a little paler in colour, fusiform, elongate, anastomosing and inclosing numerous crowded, concolourous pits, margin of the ribs sterile. Stem yellowish white, furfuraceous at the apex and at the swollen, sulcate base. Paraphyses branched, very slightly coloured, septate, fusiformly thickened at the apex. Asci cylindrical, 8-spored, scarcely attenuated at the base, $350\text{-}400 \times 25\text{-}28\mu$. Spores large, elliptical, $25\text{-}30 \times 16\text{-}18\mu$.

On the ground, Nottingham, 30th April, 1907.

Distinguished from *Morchella vulgaris* by its smaller size, brown colour, smaller more crowded pits with thinner, deeper, less prominent ribs and the fusiform apices of the paraphyses.

Aleuria umbrina Boud. In Cke. Mycogr. fig. 378; Boud. Hist. et class. Disc. 46; Boud. Icon. Mycol. IV., 152, t. 279; non Pers. Obs. II, 77.

Large, 2-8 cm. across, often caespitose, cup-shaped, fuliginous, greyish white on the outside and densely furfuraceous.

Ascophore fairly thick, fragile, furfuraceous and dentate at the margin; disc dark fuliginous when moist, more or less undulate, whitish on the exterior and tinted with the coloured meal. Paraphyses slightly club shaped, 7-8μ thick at the apex, hyaline or slightly coloured. Asci cylindrical, slightly attenuated at the base, 8-spored, turning blue with iodine, 280-310×13-14μ. Spores elliptic-oblong, white, verrucose, 17-20×7-9μ.

On charcoal heaps, Eymore Wood, Worcestershire, 29th May, 1913, C. R.

Sepultaria tenuis (Fckl.) Cke. Fckl. Symb. Myc. 322; Boud. Icon. Mycol. IV., 203, t. 362.

Ascophore small, 1-1·5 cm. across, at first cup-shaped, then soon convex and torn up into many round lobes, caused by the growth of the asci which distend the hymenium and make the margin swell out in roundish segments; disc greyish white or glaucous, pale on the outside and covered with fasciculate, long, flexuose, brown, septate, hairs. Paraphyses uncoloured, stouter, septate, not or slightly thickened at the apex, filled with colourless granules. Asci fairly large, not becoming blue with iodine, scarcely attenuated at the base, 210-240×20-22μ. Spores white, elliptical, having a large, central, slightly yellowish oil drop, sometimes divided up into two and accompanied with smaller granules at each end, 20-26×13-15μ.

Amongst moss in a beech wood near Cambridge, 10th Novr., 1913, Mr. F. T. Brooks.

Characterized by its *small* size and the swelling up of the margin of the ascophore into *rounded lobes*.

SPHAERIDIOBOLUS Boud. Bull. Soc. Myc. Fr. I, 108; Hist. et class. Disc. 73.

This genus differs from *Ascobolus* in its *round* and somewhat *paler coloured* spores.

Sphaeridiobolus hyperboreus (Karst.) Boud. var. *niveus* Quél. Karst. Mon. Ascob. Fenn. 204; Myc. Fenn. I., 80; Boud. Bull. Soc. Myc. Fr. I, 108; var. *niveus* Quél. Suppl. X, 16; Boud. Hist. et class. Disc. 73.

Gregarious, sessile, somewhat plane, 40-70μ wide, pure white at first, becoming darker when the projecting asci ripen, glabrous. Asci cylindrical, 90-200×15-22μ, operculum pointed, slightly attenuated at the base, 8-spored. Spores round, 12-13μ in diam., 1-seriate, at first smooth and hyaline, then finally verrucose and brownish-violet. Paraphyses hyaline, slender, 2-3μ wide at the apex, septate, simple or branched.

On old hedge cuttings, showing some slight traces of mouse dung, Perth, 18th February, 1913, Mr. James Menzies.

My thanks are due to our fellow member, Monsieur E. Boudier, for kindly confirming the determination of this *Sphaeridiobolus.* It is characterized by the pure snow white colour of the ascophore and the globose, verrucose, brownish-violet spores when mature.

Rhyparobius albidus Boud. Bull. Soc. Myc. IV., XLIX; Icon. Mycol. IV, 238, Pl. 418.

Very small, 20-40μ wide, white, scattered or gregarious, hemispherical then lens-shaped, immarginate, glabrous. Hymenium plane, then convex, due to the projecting asci. Paraphyses cylindrical, fairly thick, septate, slightly thickened at the apex, 2-3μ in diam. Asci broad, clavate, slightly attenuated at the base, 32-spored, 40-50 × 15-25μ. Spores white, hyaline, smooth, oblong-fusiform, 10-13 × 5-6μ, the ripe spores collecting in an oval mass at the apex of the ascus.

On old hedge cuttings of *Cytisus scoparius* showing some slight traces of dung, Perth, 25th February, 1913, Mr. James Menzies.

These specimens agree well with the above description with the exception that the asci are much longer, 70-90 × 15-24μ, and the number of the spores in each ascus varies from twenty-four to thirty-two.

Helotium sparsum Boud. Hist et class. Disc. 111; Boud. Icon. Mycol. IV., 289, t. 495 and see plate 9.

Minute, white, ·5-1·5 mm. across, shortly stipitate. Ascophore turbinate then expanding, slightly marginate, glabrous; stem concolorous, sometimes somewhat yellowish at the base. Paraphyses linear, scarcely thickened at the apex and granular within. Asci fairly large, slightly attenuated at the base, clavate, 8-spored, foramen marginate, 105-125 × 10-14μ. Spores white, oblong-fusiform, often slightly curved, containing some small granules at each end, 15-22 × 5-6μ.

On the mid-rib and veins of dead Oak leaves, near Perth, 27th October, 1913, Mr. James Menzies.

Encoelia tiliacea (Fr.) Karst. Fr. Syst. Myc. II; 76. Karst. Pez et Asc. 11; Myc. Fenn. I., 218. Bres. Fungi. Trident. I, 93. pl. CV.

Ascophores subcaespitose, erumpent, sessile, 3-6 mm. across, becoming plane and deformed, bare and rugose on the exterior, waxy or waxy-coriaceous, flesh colour then cinnamon becoming fuscous. Asci cylindric-clavate, 80-130 × 6-8μ. Spores 2-seriate, oblong or elongate, often curved, many-guttulate, 11-18 × 3-4μ, hyaline. Paraphyses thickened at the apex.

On a dead Lime branch, Inver, Perthshire, 23rd January, 1914, Mr. Charles McIntosh.

NEW OR RARE MICROFUNGI.

By A. Lorrain Smith, F.L.S., and J. Ramsbottom, M.A.

We have again to thank Mr. D. A. Boyd for forwarding to us for examination the very interesting material he has gathered. In certain cases old records are given which have been apparently overlooked and diagnoses of the fungi are added where these are lacking in British books.

CHYTRIDIACEAE.

Synchytrium cupulatum Thomas in Bot. Centralbl. XXIX., p. 19 (1887).

Galls small, globose or elongate, later somewhat collapsed, carmine-red to black, the host cells filled with carmine-red cell-sap; resting spores solitary or rarely in pairs, globose or slightly flattened, ellipsoid, 50-150μ diam., with a thick, brown, smooth epispore, the contents yellow-red. Germination unknown.

On Rosaceae. Coll. D. A. Boyd on leaves and stalks of *Potentilla* sp., at Beae Loch, near Beith, Ayrshire, July, 1913.

Cladochytrium graminis, Büsgen. Cohn. Beitr. zu Biol. IV. p. 280 (1887). G. Massee in Kew Bull, 1913, p. 205.

This parasite was first observed in this country in 1908. It has appeared in several widely separated localities in the South of England, attacking *Festuca* spp. and other grasses with small leaves and is consequently most prevalent on lawns, tennis grounds, bowling greens, etc. The symptoms of its presence are the appearance of small yellowish patches a few inches across scattered over the lawn. These patches gradually increase in size and often encroach on one another, forming large irregularly shaped areas which eventually become brown owing to the entire disappearance of the grass.

PERONOSPORACEAE.

Cystopus Portulacae Lév. in Ann. Sci. Nat. VIII. p. 371 (1847).

Parasitic on leaves of *Portulaca oleracea* and *P. sativa*.

G. Massee in Mildews, Rusts and Smuts (1913) p. 12.

C. Bliti Lév. in Ann. Sci. Nat. VIII., p. 373 (1847).

Parasitic on stems and leaves of various species of *Amaranthus*, *Cyathula* and *Acnida*.

G. Massee l.c.

Plasmopara pusilla Schroet. in Krypt-fl. Schles III., 1., p. 237 (1886).

Parasitic on living leaves of *Geranium pratense*, *G. phaeum*, *G. silvaticum*, etc.

G. Massee Tom. cit. p. 18.

Sclerospora graminicola (Sacc.) Schroet. Krypt-fl. Schles. III., 1, p. 236 (1886).

Parasitic on leaves of grasses (*Phalaris*, *Alopecurus*, *Setaria* and *Zea*).

G. Massee Tom. cit. p. 16 as "*S. graminis* Schroet."

Phytophthora erythroseptica Pethybridge in Sci. Proc. Royal Dublin Soc., Vol. XIII. (1913), p. 547; see also Vol. XIV. (1914), p. 179.

The fungus causes a new form of potato rot for which the name "Pink Rot" is suggested. The rot is rapid and, on the whole, would be called a wet rather than a dry one. The cut surfaces of affected tubers quickly turn pink when exposed to the air, and later become almost black. Plants, in the roots, rhizomes, stems and tubers of which the fungus has been found, exhibit symptoms of disease in their sub-aerial organs, and it is believed that these symptoms which are of the "wilt" type, are due to the invasion of the plant by the parasitic fungus. The name "Pink-Rot Wilt" is suggested for this disease. The development of the sexual organs is peculiar. The oogonial incept enters the antheridium at or near its base, grows up through it and out at the top, expanding there to form the oogonium proper in which the oospore develops. It is not certain whether fertilization occurs, but if it is so, it would appear to take place before the formation of the oosphere. The reproductive organs have been found in all of the underground parts of the plant. The conidia may germinate either by producing germ-tubes direct, or by the formation of zoospores. The oospores have been caused to germinate after a suitable period of rest. The peculiar method of fertilization is now also known in *Phytophthora infestans*, *P. Phaseoli*, *P. parasitica*, *P. Colocasiae*, and possibly also in *P. omnivora* var. *Arecae*. Pethybridge suggests that only those species whose sexual organs are developed according to the *infestans*-type should be retained in the genus *Phytophthora* and that those in which the *omnivora*-type as described by de Bary

occurs (e.g., *P. Cactorum*, *P. Fagi*, *P. Syringae*) should be placed in a new genus *Nozemia* (for generic diagnosis and emended diagnosis of *Phytophthora* see Tom. cit. p. 556). He considers that *Phytophthora* should be withdrawn from the Peronosporaceae and should be made the type of a new family Phytophthoraceae.

DISCOMYCETES.

Endomyces Magnusii Ludwig in Ber. Deutsch. Bot. Gesell, p. xvii., 1886.

Mycelial hyphae filiform, long, everywhere branched, septate, hyaline; asci very copious in acrogenous branches, ovate-ellipsoid, 40-45$\mu \times$ 25μ, tetrasporous; spores ellipsoid, sparingly but conspicuously verruculose, hyaline 12-15$\mu \times$ 8-10μ.

G. Massee in Kew Bull., 1907, p. 240.

"This is one of the organisms always present in the 'slime-flux' or glairy substance dripping from the large weeping wounds often present on the trunk or larger branches of trees." We have had this fungus forwarded to us in pure culture by Dr. R. Craik who obtained it from exudations from various trees.

MICROGLOSSUM ROBUSTUM (Durand) nov. comb. *Corynetes robustus* Durand. Ann. Mycol. VI. p. 416 (1908). *Leptoglossum robustum* Sacc. et Trav.

Plants solitary or gregarious often caespitose, black or brownish black, 2·5-8cm., high, stout; ascigerous portion occupying about $\frac{1}{4}$ to $\frac{1}{2}$ the total length, not sharply differentiated from the stem, black with an olive-brown tint, pyriform-elliptical, obtuse, 1-3cm. long, 6-15 mm. broad, more or less compressed or longitudinally furrowed, sometimes twisted, hollow, flesh dark brown; stem terete or compressed, paler, shining brownish black, hygrophanus, lightly squamulose above, 1-4 cm. high, 3-8 mm. thick. Asci clavate, stout, sessile or shortly stipitate, apex narrowed, pore blue with iodine, 100-150 $\times$ 10-15μ (120-135); spores 8, biseriate above, uniseriate below, hyaline, smooth, cylindrical, slightly narrowed towards each end, at first continuous, multiguttulate, finally 7-11-septate, straight or curved, 25-50 $\times$ 4-6μ (30-40); paraphyses hyaline, filiform, branched, 2-3μ thick, the apex slightly irregularly thickened, usually curved or uncinate at the tips which are not or only slightly agglutinated into an epithecium.

Closely related to *Microglossum (Geoglossum) atropurpureum* but differs in the more robust, compact, caespitose habit, larger spores, and absence of the conspicuous vinaceous-brown epithecium so noticeable in that species. The paraphyses are also more inclined to be thickened and more strongly curved above.

Top of Montpelier Hill, Co. Dublin (1,200ft. elevation). Found previously only in North America.
R. L. Praeger in Irish Naturalist, Vol. XXIII., p. 49 (1914).

Belonidium punctum (Rehm) Rabenh. Krypt. Fl. I., 3, p. 569. *(Niptera punctum* Sacc.*)*

On dead dry leaves of *Nardus stricta.* Broxa Moor, near Scarborough.
C. Crossland in Naturalist, 1913, p. 175. (T. B. Roe).

Dasyscypha abscondita Massee.

Gregarious on fading leaves growing under a cask, Queen's Cottage Grounds, Kew.
G. Massee in Kew Bull. 1906, p. 46. (G. Nicholson).

Humaria pinetorum (Fuck.) Quél. Enchir. fung. p. 291 (1886).

Apothecia gregarious, cone shaped, with shallow, paler, disc with an acute and darker border, attenuated below into a stalk, 1 mm. high, black, about 4 mm. broad, exterior gray. Asci clavate, rounded and thickened above, c. $150\mu \times 12\mu$, eight spored. Spores spindle shaped, straight or somewhat bent rather pointed, continuous, without large oil drops, colourless, $18\text{-}21\mu \times 6\text{-}7\mu$, biseriate. Paraphyses thread-like c. 3μ broad, colourless. Ascus pore bluing with iodine.
On fallen pine leaves in the Arboretum, Kew.
G. Massee in Kew Bull, 1906, p. 46. (G. Nicholson).

LAMPROSPORA de Not (ex. Boud.).

Differs from *Humaria*, as emended by Boudier, in having round spores, which are usually verrucose and not smooth as is usual in *Humaria.* Always small in size, yellow or orange in colour, terrestrial, carbonicolous or muscicolous.

L. Crec'hqueraultii (Cr.) Boud. Icon. Mycol. IV., p. 229, t. 404.

Receptacle 2-5 mm. in diam., lenticular, finely marginate and entirely of a golden-yellow; at first hemispherical with a very small denticulate margin, then becoming lenticular with the hymenium more or less convex and coloured. Paraphyses fairly thick, scarcely flexuose, simple or divided only at the base, scarcely thickened at the tips, filled with coloured protoplasm, divided by vacuoles and colouring green with iodine. Asci fairly large, broad, scarcely narrowed at the base, 8-spored, not colouring blue with iodine, $250\text{-}320\mu \times 22\text{-}25\mu$. Spores white, round, covered with thin pointed spines, $20\text{-}25\mu$ diam. with the spines, $15\text{-}20\mu$ without.
Recorded by Cooke, Grevillea XVIII., p. 88 (1890), as *Peziza*

auriflava Cooke. "This very distinct species of the section *Humaria* has been found by Mr. E. Pearl, on clay soil at Helston, in Cornwall."

Rhyparobius crustaceus (Fuck.) Rehm. var. *myriadeus* Karst. Myc. Fenn., p. 81.

Similar to the type but asci with 24-32 spores, clavate, $44\mu \times 11\mu$.

On sheep dung. Orkney.

J. W. H. Trail in Scot. Nat., p. 183, 1889.

There is also a specimen in Phillips' Herbarium (British Museum) from Professor Trail, on horse dung.

R. myriosporus (Cr.) Boud. in Ann. Sci. Nat. Sér. 5, X., p. 240 (1869).

Apothecia crowded, rarely sparse, spherical then with flattened disc, light flesh-colour or rose red, ·1-·2 mm. broad; asci two to four in an apothecium, ovoid, thick-walled, rounded above, 100-$150\mu \times 50$-60μ, containing 200-250 spores. Spores elliptical, continuous, colourless, $6\mu \times$ -4μ, lying in a heap. Paraphyses rare, thread-like, septate, ovate, somewhat curved, colourless, -3μ broad. Excipulum parenchymatous, rose red.

On sheep-dung and horse dung, Orkney.

J. W. H. Trail l.c.

R. brunneus Boud. Tom. cit. p. 237.

Apothecia very crowded together, very minute, very scanty, smooth, tawny brown paler at base, disc of the same colour, sub-convex, asci oblong, broad with acute base; spores 32, oblong-ovoid, minute, hyaline subacute at both ends; paraphyses rare, septate with scarcely thickened tips.

On cow dung and grouse dung, Orkney.

J. W. H. Trail, l.c. Specimen in Phillips' Herbarium.

Ascozonus niveus (Fuck.) Boud., Hist. et Class. Disc. p. 79.

Apothecia scattered, plane, scarcely somewhat concave, finely downy at the margin, hyaline-diaphanous, snow-white, puncti-form, up to 1 mm. broad; asci elongate-ovate, stalked, bent, containing 64 spores, c. $60\mu \times 21$-25μ; spores elliptical, continu-ous, colourless, 6-$7\mu \times 3\mu$; paraphyses wanting.

On rabbit dung, nr. Aberdeen.

J. W. H. Trail, l.c. Specimen in Phillips' Herbarium.

Taphrina caerulescens (D. et M.) Tul. Ann. Sci. Nat. 1866, p. 127.

Hypophyllous, spots suborbicular, at length irregularly con-fluent, producing bladder-like distended areas often covering

and deforming half the leaf, bluish fulvescent, paler beneath; asci widely cylindrical, with abruptly attenuated base, 55-70$\mu \times$ 15-20μ, forcing their way between the epidermal cells with their lower end sometimes to a depth of 25μ, no basal cell; ascospores germinating almost without exception in the still unopened ascus, which therefore, when ripe, is filled with an immense number of small elliptical yeast like sporidia, 2μ in diam.

J. W. H. Trail in Trans. Perth. Soc. Nat. Sci., Vol 2, p. 130, (1895).

"Found on oak leaves, causing spots discoloured and prominent above, concave and at first pale below, where the asci are formed after a time. This obscure parasite, though not previously recorded from Scotland is not rare in various districts from Perth to Aberdeen."

Exoascus Crataegi (Sadeback) Sacc. Syll. X. 70 (1892) *Taphrina* Sad.

Asci cylindrical, truncate at each end, 25-35$\mu \times 8\mu$, supported by a basal cell 6-8μ diam.; asci 8-spored, spores globose, 4·5μ diam.

Rather rare on leaves and flowers of *Crataegus Oxyacantha*. The attacked leaves turn red and become wrinkled and twisted. The asci do not penetrate between the cells of the epidermis.

On *Crataegus Oxyacantha*, Oxted, April 3rd, 1903. V. H. Blackman in Herb. Brit. Mus.

DISCINELLA MENZIESI Boud. in litt.*

This beautiful fungus, described and figured in the last number of the Society's Transactions, from Perth, has been found by Mr. D. Garnett, growing amongst moss at Silchester, Hants, December and January. The latter collection was made after very severe frost. Young specimens are white and turbinate. Many spores in the mature specimens reached a length of 22μ.

PACHYDISCA Boud. Bull. Soc. Mycol. Fr., I., p. 112 (1885) and Hist. et Class. Disc Eur., p. 93 (1907).

Receptacle relatively very thick and convex, covered with the hymenium, the asci always with marginate pores and octosporous; paraphyses straight, simple, or branched only at the

* "Merci beaucoup pour l'indication que vous me donnez sur *Calycella Menziesi*. A ce subjet je vous dirai que j'ai reconnu que cette espéce ne devait pas être placée dans le genre *Calycella* mais bien dans les *Discinella*. Le taille et la station épigée la preuve. Je ne sais comment j'ai fait cette erreur dans ma description; un 'lapsus memoriae' sans doute."

base, rarely with oleaginous granulations. Spores always with guttulae and granulations, often finally having a median wall.

Similar to *Ombrophila* but differing in the receptacle being much less frequently stipitate, and in the guttulate spores. Comprising numerous species growing on wood or on the *débris* of decaying vegetation.

Pachydisca fusisporum (Schroet.) Boud. Hist. et Class. Disc. Eur., p. 93.

Apothecia gregarious, usually arranged in spots, sessile, flat or slightly arched, with sharp border or somewhat fringed, ochre to golden in colour, disc about 1 mm. broad, externally slightly streaked, when dry more concave and surrounded by a rim. Asci club-shaped, cone-shaped above, shortly stalked, $90\text{-}100\mu \times 7\text{-}9\mu$, 8-spored. Spores spindle- or almost needle-shaped, slightly bent, continuous $20\text{-}24\mu \times 2\text{-}2{\cdot}5\mu$, lying in many rows. Paraphyses rounded above, up to 4μ wide.

On birch bark.

Coll. W. B. Grove, Clows Wood, Earlswood, nr. Birmingham, Nov., 1913.

HYALOSCYPHA Boud. Hist. et Class. Disc. Eur. p. 126 = ALLOPHYLARIA Karst.

This genus is characterised by its receptacles being slightly hairy, especially towards the margin, sessile, fairly thick and always a little translucent. The species are small, having some resemblance to those of *Hyalinia* but they differ in their villosity. Asci claviform, octosporous, with foramen little or not marginate. Paraphyses slender, simple or branched. Spores oblong and often a little claviform. The hairs which cover the receptacle are attenuated at the tips and septate.

H. leucella (Karst.) Boud. l.c. *Helotium* Karst. *Pezizella* Sacc.

Apothecia mostly scattered, sessile, spherical when closed, then pitcher-shaped and finally spread out, whitish to colourless, rolled up when dry, white, externally somewhat downy, ·1-·4 mm. broad, waxy; asci clavate, tips obtuse, $45\text{-}60\mu \times 7\text{-}9\mu$, octosporous; spores spindle-rod shaped, straight or somewhat bent, continuous, with small oil drops, colourless $13\text{-}18\mu \times 1{\cdot}5\text{-}2{\cdot}5\mu$; generally biseriate, seldom obliquely uniseriate; paraphyses slender, $2\text{-}2{\cdot}5\mu$ broad above, colourless; sheath prosenchymatous, colourless, with projecting hyphae; ascus pore coloured blue with iodine.

Specimen in Phillips' Herbarium, collected by J. W. H. Trail "on branch of *Alnus glutinosa*," April, 1887, near Aberdeen.

HYSTERIACEAE.

Lophodermium Rhododendri Ces. Erb. critt. ital. No. 537.

On dry leaves of *Rhododendron ponticum*, Raincliffe Woods, Scarborough.

T. B. Roe in Naturalist, 1913, p. 218.

"The rhododendra affected, which are in a damp, unfavourable situation in the wood, show at first reddish spots on the living leaves, and afterwards the mature black elliptical ascophores are produced on the fallen leaves. This species . . . has only one previous record for Britain, and that from the county of Surrey."

PYRENOMYCETES.

Podosphaera myrtillina Kunze. Mycolog. Hefte II., p. 111.

This species was found on leaves of *Vaccinium Myrtillus* several times during the Haslemere foray of the Society. This is apparently the first English record of the species which was previously found by Mr. Boyd in various parts of Scotland.

Diaporthe (Tetrastaga) insignis Fuck. Symb. Myc. App. II., p. 36 (1873).

On *Rubus fruticosus*. Mulgrave Woods, Yorkshire.

C. Crossland in Naturalist, 1913, p. 174. (H. C. Hawley).

Melanomma (Trematosphaeria) paradoxa. Winter, Rabenh. Krypt. Fl. I., 2, p. 276 (1887).

On oak wood. Mulgrave Woods, Yorkshire.

C. Crossland in Naturalist, 1913, p. 175. (H. C. Hawley).

CERIOSPORELLA POLYGONI N. SP.

Peritheciis confertis, numerosis, atris, carbonaceis, membranaceis, depresso-globosis, c. 600μ diam., sub epidermide insidentibus, ostiolum emittentibus; ascis cylindraceo-clavatis, apice obtuse rotundatis, basi attenuatis, 35-45$\mu \times$ 4-5μ, octosporis, aparaphysatis; sporidiis oblique subdistichis fusiformibus, utrinque mucronatis, 9-12$\mu \times 2\mu$; mucronibus 4μ longis; primum 3-4-guttulatis dein medio 1-septatis, hyalinis.

In caulibus siccis *Polygoni amphibii* var. *terrestris*.

Coll. D. A. Boyd, Ardrossan, Ayrshire, Feb., 1913.

SPHAEROPSIDEAE.

APOSPHAERIA POPULEA N.SP.

Pycnidiis superficialibus, sparse gregariis, junioribus globulosis, vetustioribus globuloso-depressis, 200-300μ diam., glabris, levibus, atrobrunneis; ostiolo rotundo; sporulis continuis, hyalinis, utrinque rotundatis 7-8$\mu \times$ 2-3μ.

Ad. *Populi* lignum decorticatum.

Coll. D. A. Boyd, Stevenston, Ayrshire, Feb., 1913.

PHOMA ORTHOTRICHI N. SP.

Pycnidiis sparsis, epidermide tectis, dein erumpentibus, atro-brunneis, globosis, poro pertusis, 50-150μ diam.; sporulis hyalinis, oblongis, rectis, exiguis, c. $3\mu \times 1\mu$.

Ad capsulas musci *(Orthotrichi sp.)*.

Coll. D. A. Boyd, Beilk, Ayrshire, July, 1912.

The extreme minuteness of the spores distinguish this from other muscicolous species.

Sphaeropsis Malorum Peck Ann. Report 1881. Sacc. Syl. III., p. 294.

Pycnidia imbedded, erumpent, usually surrounded by a broken epidermis, depressed conical, apex perforate; sporidia oblong, on basidia of the same length, $25\mu \times 10\text{-}11\mu$ [$22\text{-}32\mu \times 10\text{-}14\mu$], brown.

Causes serious injury to apple, pear and quince in U.S.A. Only recently reported as occurring in this country. Trunk, branches, leaves and fruit are all attacked. On the trunk and branches the fungus causes roughening of the bark, either as local patches or extending for considerable distances, destroying bark and exposing wood. The fungus may attack the fruit while still on the tree but is most abundant on the fallen fruit causing a brown rot.

Journ. Board of Agric., XX., p. 513 (1913).

Gloeosporium Crotalariae, Massee, in Kew Bull., 1913, p. 198.

Parasitic on young shoots of *Crotalaria juncea*, Kew.

Colletotrichum concentricum, Massee l.c.

On the fruit of the Snake gourd, *Trichosanthes anguina*, in the Lily-house, Kew.

A destructive parasite forming large bleached patches on the fruit, which become covered with irregularly concentric rings of orange spore masses.

CONIOTHYRIUM PEPLIS N. SP.

Maculis nullis. Pycnidiis punctiformibus, confertis, globoso-depressis, 170-220μ diam., primum epidermide velatis, dein expositis et sordide-griseis, ostiolo minutissimo pertusis. Sporulis numerosissimis, elliptico-subglobosis, apiculatis, biguttulatis, initio hyalinis dein fuscis, in acervis atris, $7\text{-}8\mu \times 5\text{-}6\mu$.

In foliis et caulibus vivis *Peplis Portulae*.

Collected by D. A. Boyd, Ardeen Sands, Stevenston, Ayrshire, Sept. 1912.

HYPHOMYCETES.

Oospora equina (Desm.) Sacc. et Vogl. Sacc Syll. IV. p. 22 (1886). *Torula equina* Desm. Ann. Sci. Nat, 1855, p. 126.

Tufts at first minutely pulvinate, velutinous, rounded, then gregarious, expanded, confluent, of a beautiful orange colour; mycelium subcreeping, branched, septate; chains long, branched, subdichotomous, suberect; conidia unequal, globose, oblong or fiddle-shaped, white, hyaline or pale orange, semi-transparent, 5-15μ thick; epispore hyaline, glabrous.

On old and mucid horse hoofs, France.

On the bones and dried skin of a cat buried two feet under the soil in Mr. Walter Wood's garden, Worcester, and exhumed after two years had elapsed on the 27th November, 1913. Kindly communicated by Mr. Carleton Rea.

Sporotrichum roseum Link Obs. I. 33 (1809).

On rotting printed paper in damp cellar, Leeds.

C. Crossland in Naturalist, 1913, p. 175 (J. W. Taylor and W. D. Roebuck).

RAMULARIA ARENARIAE, n.sp.

Maculis variis rotundatis vel irregularibus flavidis interdum zona brunnea cinctis, caespitulos plures, epiphyllos, albos emittentibus; conidiosphoris copiosis, hyalinis, filiformibus, fasciculatis, circa 35$\mu \times$ 2-3μ, conidiis cylindraceis, utrinque rotundatis uniseptatis, hyalinis, 17-25$\mu \times$ 2-3μ.

In foliis *Arenariae trinerviae.*

Coll. D. A. Boyd, Lochwinnoch, Renfrewshire, July 1912.

Hormiscium Centaurii (Fuck.) Sacc. Syll. IV., p. 265 (1886).

Chains of conidia fasciculate, at length confluent, dark olivaceous; articulations globose, generally when old eight to nine in number, not breaking apart.

Covering the stem, leaves and flower of *Erythraea umbellatum (Centaurium).*

Coll. on the living leaves of *E. umbellatum* by G. O. Searle, near Ashford, Kent, August 1913.

The above is a translation of Fuckel's description. The specimen examined by us differed in that the spores were more cuboid than globose (3-4$\mu \times$ 2-3μ) and the number of spores in a chain often reached fifteen or more in number without disarticulating.

Trichosporium chartarum Sacc. in Rev. Mycol. VII., p. 224 (1885).

On damp wall-paper, near Halifax; on rotting printed paper in damp cellar, Leeds.

C. Crossland in Naturalist, 1913, p. 175 (J. W. Taylor and W. D. Roebuck).

See also Trans. Brit. Mycol. Soc., 1913, IV. p. 182.

Brachysporium Wakefieldiae Massee in Kew Bull., 1913, p. 198.

Forming scattered olive patches on the hymenium of a species of *Corticium*, Kew.

Stemphylium piriforme Bon. Handb. Allgem. Mykol. p. 83, fig. 74 (1851).

Mycelium forming dark spots, branched, septate, smoke-coloured. Conidia terminal on the branches, obpyriform or of various shapes 3-4 septate, slightly constricted at the septa, dark-coloured, 25-30μ × 12-15μ.

Usually on dead branches. Occurring on an exposed culture, Bristol. Sent by Chas. Hunter.

CHAETOSPERMUM Sacc. Syll. Vol. X., p. 706 (1892).

Sporodochia gelatinous, sporophore branched. Conidia ovoid (? ellipsoid), hyaline, with hair-like appendages at each end.

C. CHAETOSPORUM. nov. comb.

Sporodochia sessile, dispersed or gregarious, ·5-2 mm. in diameter, white, gelatinous, orbicular; sporophores branched, hyaline; conidia elongate-ellipsoid, 38-43μ × 8-10μ (or slightly longer), hyaline, containing numerous guttulae, and bearing 7-8 bristles at each end equal in length to the conidium.

On decaying grasses. Coll. Miss G. Lister, on decaying leaves (?beech) in wood near Rodborough Common, Sept. 1913.

This fungus was described by Patouillard (Bull. Soc. Bot. Fr. 34 p. XL. (1887)) as a new species of *Tubercularia*, *T. chaetospora*, though he recognised that it did not agree well with the previously described species of that genus. Saccardo made it the type of a new genus *Chaetospermum* on account of the peculiar spores, but changed the specific name to *tuberculari-oides*. By the International rules of nomenclature the first specific name must be used and the fungus must be known as *Chaetospermum chaetosporum*.

Stysanus microsporus Sacc. in Michelia I., p. 274, (1878).

Coremia congregate, grey then dark-brown. Stalks slender composed of delicate, smoky-brown filaments almost without cross-septae. Conidia at the tips of loose hyphae in chains, almost globose, colourless, extremely minute, 2-4μ × 2-2·5μ.

On bark, Witley Park, Worcestershire. Comm. Carleton Rea, March 1913.

Stemmaria aeruginosa, Massee in Kew Bull. 1913, p. 199.

On bird dung, Kew.

Arthrosporium elatum, Massee, l.c.

On decaying fragments of grass, Kew.

"This differs from typical species in having 1-septate spores, but conforms in all other respects."

UREDINEAE.

Uromyces Jaapianus Klebahn, Kryptogamenflora der Mark Brandenburg, Va Pilze, p. 239 (1913).

Uredospores roundish or slightly oval, 20-25$\mu \times$ 20-23μ; membrane golden brown, thick, 2-3μ, with warts 2·5-3μ apart; germ pores 5-6, without noticeable papilla. Teleutospores roundish or obovate, 19-22$\mu \times$ 16-20μ; membrane darker brown, thick, 2-3μ, with warts 2·5-3μ apart and symmetrically disposed; over germ pore hardly perceptible papilla; stalk rather short.

On *Trifolium dubium (minus)*.

Differs from *U. striatus* by its larger thick-walled uredospores without papillae, and the symmetrically disposed warts (not in streaks) of the teleutospores which are thick-walled with an insignificant papilla.

There are two collections of this fungus in the Broome Herbarium (British Museum) collected near Bath. W. B. Grove in his monograph remarks concerning *U. striatus* (p. 94), "The teleutospores on *T. minus* which I have observed are more distinctly verrucose and less striated than in the figures given by Fischer, and may possibly not belong to the same species." Cf. Trans. Brit. Mycol. Soc. IV., p. 184 (1913).

Uromyces striatus Schroet.

G. Massee in Mildews, Rusts and Smuts, p. 76.

"Recorded from Jersey." A list of host plants is given including "*Trifolium minor*," but it is not indicated on which of these the Jersey fungus was parasitic.*

Uromyces Aconiti-Lycoctoni (DC.) Wint in Pilze Deutschl, p. 183 (1884).

(*U. Aconiti* Fuck. Symb. Mycol., p. 61, 1869).

On *Aconitum Lycoctonum*, and other species of *Aconite*. "Sometimes occurs on cultivated plants in this country."

G. Massee in Mildews, Rusts and Smuts, 1913, p. 79.

Puccinia Intybi (Juel) Syd. in Oesterr. bot. Zeitschr, 1901, p. 16.

On living leaves of *Crepis praemorsa*.

P. and H. Sydow Monographia Uredinearum Vol. I. (1904) p. 68, and G. Massee, l.c. p. 102.*

P. Helianthi Schw. Syn. Fung. Carol., p. 73 (1822).

On leaves of cultivated sunflower *(Helianthus annuus)*.
G. Massee l.c.

P. Prenanthis-purpureae (DC.) Lindr. Act. Soc. Fauna et Fl. fennica XX., p. 7 (1901).

Confined to *Prenanthis purpurea.*

P. and H. Sydow Tom. cit., p. 135 and G. Massee Tom. cit., p. 105.*

P. Peucedani-parisiensis (DC.) Lindr. Act. Soc. Fauna et Fl. fennica XXII., p. 79 (1902).

On *Peucedanum.*

P. and H. Sydow Tom. cit., p. 402 and G. Massee Tom. cit., p. 122.*

Puccinia Prostii Moug. in Duby Bot. Gall. II., p. 891 (1830).

On leaves of cultivated Tulips.
G. Massee Tom. Cit., p. 139.

Puccinia Elymi Westendorp. Bull. Acad. Belg. XVIII. (1851), p. 405. *(Rostrupia Elymi* Lagerh.*)*

On leaves of *Elymus arenarius*, Palling, Norfolk.
G. Massee Tom. cit., p. 179.

Chrysomyxa Rhododendri de Bary in Bot. Zeit., p. 809, 1879. See also Grove, The British Rust Fungi, p. 384.

Mr. D. A. Boyd collected this fungus on *Rhododendron hirsutum* at Douglas Castle, Lanarkshire. The specimens forwarded to us had both uredospores and teleutospores. Afterwards specimens were sent to Mr. Grove but apparently he did not find teleutospores present. Those found by us agree with the description given in Grove l.c.

USTILAGINEAE.

Cintractia patagonica Cooke and Mass. Grev. XVIII., p. 34, (1889).

On *Bromus unioloides* and *Festuca bromoides.*
G. Massee Tom. cit., p. 203.

"This species was founded on material received at Kew, from Patagonia. Some time afterwards an English traveller in South America observed that *Bromus unioloides* was mixed with lucerne, for fodder. Seed of this grass was brought home, sown, and in due course produced not only fruit, but also its parasite, *C. patagonica* which was received at Kew a second time for identification."

* See "Notes on the nomenclature of some rusts," p. 332.

NOTES ON THE NOMENCLATURE OF SOME RUSTS.

By J. Ramsbottom, M.A.

In the last Transactions of the British Mycological Society a list of the British species of Uredinales was published.* Since the appearance of this list two books dealing with rusts have appeared—W. B. Grove "The British Rust Fungi" and G. Massee "Mildews, Rusts and Smuts." It has been thought advisable to indicate how these works affect the list and also to point out one or two errors so that the enumeration may be useful as a check list. In comparing the list with the two books the question of nomenclature has cropped up, as in at least one case the same fungus appears under three different names! This naturally calls for some comment, and an attempt has been made to work out the "legal" name according to the International Rules (Brussels 1910). These rules state that the nomenclature begins in this group with Persoon's Synopsis 1801, and that the earliest specific name given to the teleutospore stage should be adopted.† Certain names used by all three authors are contrary to these directions and some of them are considered below. The whole of the British species have been under review, but only those cases are given which seem amenable to immediate treatment. "The essential points in nomenclature are: 1, to aim at fixity of names; 2, to avoid or to reject the use of forms and names which may cause error or ambiguity or throw science into confusion" (Art. 4). It is hoped to consider some other names in future notes.

Uromyces Ornithogali should be deleted from the list. Apparently all the British records have really been of *U. Gageae* as is, of course, easily discernible where the host plant has been given. *Uromyces appendiculatus* is a synonym of *U. Phaseoli* (see below). Both Grove and Massee reject with reason *U. Alliorum* of Cooke, the former regarding it as partly *U. ambiguus* and partly *Puccinia Porri*, the latter as the mesospores of *P. Porri.* Sydow queries it as a synonym of this species. In the genus *Puccinia*, Grove considers *P. difformis* and *P. Silai* separately. These in the list are included in *P.*

* p. 98.

† Cf. Trans. Brit. Mycol. Soc. IV., p. 98 (1913).

punctata and *P. bullata* respectively. Owing to difference in the treatment of species *P. dispersa* and *P. sessilis* have entirely different values in Grove from that given them by the other authors, where they are the equivalent of his *P. secalina* and *P. digraphidis*. The genus *Endophyllum* with its two species *E. Sempervivi* Lév. and *E. Euphorbiae-silvaticae* (DC.) Wint. was unfortunately missed from the list (at least when it was printed). Other differences, such as the treatment of *Triphragmium* and *Phragmidium*, and the rejection of certain records seem to call for no comment here. It might, however, be pointed out that Grove follows Arthur in placing *Phragmidium Tormentillae* in the genus *Kuehneola*, whereas Massee sinks this species under *P. Fragariastri*. Massee also considers that the English record of *Hemileia Phaji* is incorrect and that the species is *H. americana;* also that *H. Oncidii* is a synonym of the latter species.

As additions to the list* are *Chrysomyxa Rhododendri* de Bary recorded by Grove, and *Uromyces Aconiti-Lycoctoni* (DC.) Wint., *Puccinia Helianthi* Schw., *Puccinia Prostii* Moug. in Duby, and *Rostrupia Elymi (Westend.)* Lagerh. recorded by Massee. (This last species is placed in the genus *Puccinia* by most authors.) *P. Peucedani-parisiensis* (DC.) Lindr. is also recorded as occurring " on *Peucedanum*." On the same page (p. 122) *P. bullata* is recorded as occurring on the same genus. The record and description appear to be copied from Sydow's "Monographia Uredinearum." The fungus which occurs on *Peucedanum palustre* in this country cannot be regarded as *P. Peucedani-parisiensis*. In Grove and the list it is placed under *P. bullata*, though this species is given with a different significance in the two cases. Two other records are those of *P. Prenanthis-purpurea* (DC.) Lindr. and *P. Intybi* Syd. Both the records and the descriptions are apparently those of Sydow. They were purposely left out of the list because the authors give no reference to either exsiccatae or literature. If Mr. Massee's book had been carefully compiled one would have regarded the insertion of these species and the exclusion of others of equal claim as being of significance, but it would seem as if no such view can be taken. No further particulars are given in the book, and so until such are available these species cannot be regarded as having been collected in this country. The species of *Uromyces* on *Trifolium minus* in the Broome Herbarium has been found on examination to be *U. Jaapianus* Klebh.† This was previously lumped with *U. striatus*. The other record in Grove is also on *T. minus*, and is also probably *U. Jaapianus*. Massee records *U. striatus* from Jersey. His description and

* See paper on "New and Rare Microfungi," pp. 329, 330, of this number.
† See "New and Rare Microfungi," p. 329.

the hosts given are apparently copied from Sydow (Cf. the spore measurements and the *lapsus calami* "Trifolium minor" and "T. arvensis"). A list of host plants is given, but it is not stated on which the Jersey rust was parasitic.

The following list deals with the nomenclature of species which are given at least two different names. The species on the Caryophyllaceae are not considered, as it is better to await infection experiments rather than juggle with the morphological differences which are certainly present in some cases. The synonomy is given only in so far as it shows the origin of the various names at present in use. What is considered to be the correct name is printed in italics. I would express my indebtedness to the "Monographia Uredinearum" of P. & H. Sydow for very many references. All these have been checked, and the date added where necessary.

Uredo appendiculata Pers. var. Phaseoli Pers. Obs. I. in Ust. Ann. Bot. XV. p. 17 (1795).
Puccinia Phaseoli Rebent. in Willdenow Fl. neom. p. 356 (1804).
P. Phaseolorum DC. Flor. fr. II. p. 224 (1805).
Uromyces appendiculata Fr. Sum. veg. Scand. p. 514 (1849).
U. Phaseolorum "Tul." de Bary in Ann. Sci. Nat. 4, XX., p. 80 (1863).
Uromyces Phaseoli Wint. in Rabenh. Krypt. Fl. I. p. 157 (1881).

Aecidium Bunii γ Smyrnii-Olusatri DC. Fl. fr. VI. p. 96 (1815).
Puccinia Smyrnii Biv.-Bernh. Stirp. rar. Sicil. Manip. IV. p. 30 (1816).
P. Smyrnii-Olusatri (DC.) Lindr. in Acta Soc. pro Fauna et Fl. fenn. XXII. 1. p. 9 (1902).

Aecidium Falcariae β Bupleuri falcata DC. t.c. p. 91 (1815).
Puccinia Bupleuri Rud. in Linnaea IV. p. 514 (1829).
P. Bupleuri-falcata (DC.) Wint. t.c. p. 212 (1881).

Aecidium Prenanthis Pers. Syn. p. 208 (1801).
Puccinia Chondrillae Corda Icones Fung. IV. p. 15 (1840).
P. Prenanthis (Pers.) Wint. t.c. p. 208, Lindr. Act. Soc. Faun. Flor. fenn. XX., 9, p. 6 (1901). [In sensu stricto]

Aecidium depauperans Vize in Gard. Chron. p. 361 (1876) 2.
Puccinia aegra Grove in Journ. Bot. p. 274 (1883).
P. depauperans (Vize) Syd. Monog. Ured. p. 442 (1904).

Uredo Petroselini DC. Flor. fr. II. p. 597 (1805).
Puccinia Aethusae Mart. Fl. Mosq. Ed. II. p. 225 (1817).
P. Petroselini (DC.) Lindr. in Acta Soc. pro Fauna et Fl. fenn. XXII., 1, p. 84 (1902).

Puccinia Asteris Duby Bot. Gall. II. p. 888 (1830).
P. Tripolii Wallr. Fl. Crypt. Germ. II. p. 223 (1833).

Uredo vagans α Epilobii-tetragoni DC. Fl. fr. II. p. 228 (1805).
Puccinia pulverulenta Grev. Fl. Edin. pl. 432 (1824).
P. Epilobii-tetragoni (DC.) Wint. t.c. p. 214 (1881).

Uredo pinguis DC. α Rosae-alpinae DC. Fl. fr. II. p. 235 (1805).
Phragmidium fusiforme Schroet. in Abhandl. Schles. Gesell. Breslau, p. 24, 1869-72 (1872).
P. Rosae-alpinae Wint. t.c. p. 227 (1881).

Sphaeria flaccida Alb. et Schwein. Conspect. p. 31 (1805).
Cronartium asclepiadeum Fr. Obs. Myc. I. p. 220 (1815).
C. flaccidum (Alb. et Schwein.) Wint. t.c. p. 236 (1881).

Uredo Helioscopiae Pers. Disp. Meth. Fung. p. 13 (1797).
Melampsora Euphorbiae Cast. obs. II. p. 18 (1843).
M. Helioscopiae (Pers.) Wint. t.c. p. 240 (1881).

Uredo Saxifragarum DC. Flor. fr. VI. p. 87 (1815).
Melampsora vernalis Niessl. in Wint. t.c. p. 237 (1881).
Caeoma Saxifragarum Schroet. in Cohn's Krypt. Flor. Schles. p. 375 (1887). [Wahrscheinlich die Aecidium-Form von *Melampsora vernalis* Niessl."]

Uredo pustulata, α Epilobii Pers. Syn. p. 219 (1801).
Pucciniastrum Epilobii Otth. in Mitth. Nat. Gesell. Bern. pp. 72, 84 (1861).
Melampsora pustulata Schroet. in Cohn's Krypt. Fl. Schles. p. 364 (1887).
Pucciniastrum pustulatum Diet. in Engler u. Prantl. Nat. Pfl. 1, 1** p. 47 (1897).

Epitea Baryi B. et Br., Ann. Mag. Nat. Hist. no. 755 (1854).
Puccinia Brachypodii Otth. in Mitth. Nat. Gesell. Bern. p. 81 (1861).
P. Baryi Wint. t.c. p. 178 (1881).

Puccinia Fragariae DC. in Encycl. Bot. VIII. p. 244 (1808).
P. Fragariastri DC. Fl. fr. VI. p. 55 (1815).
Phragmidium Fragariastri (DC.) Schroet. in Cohn's Krypt. Fl. Schles. p. 351 (1887).
Phragmidium Fragariae (DC.) Wint. t.c. p. 228 (1881).

PUCCINIA EXPANSA. In the list *P. Senecionis* Lib. is recorded. Grove considers that Plowright was wrong in regarding his rust on *Senecio aquaticus* as this species; it is *P. expansa* Link., the true *P. Senecionis* Lib. not having yet been found in this country. Massee (p. 106) describes both these species, giving references to the exsiccatae of Cooke, and Vize for *P. expansa* (also given in Sydow) and a reference to Plowright's Monograph for *P. Senecionis*.

PUCCINIA TINCTORIICOLA. This is the name given in the list to a fungus growing on *Serratula tinctoria*. This was first described by Magnus in Abhand. Nat. Gesell. Nurnberg XIII. p. 37 (1900) under the name *P. tinctoriae*, the name adopted by Grove. There is a previously described *P. tinctoria* of Spegazinni (Fg. Guar. I. p. 53, 1886) and Magnus in Oesterr. bot. Zeitschr. p. 491 (1902) rightly suggested changing the name of his fungus to *P. tinctoriicola* to prevent confusion.

Certain names given in all three lists are "illegal"; in other cases where different names are given none of these are correct.

UROMYCES POLYGONI-AVICULARIS Nov. comb. This fungus was first described by Persoon (Disp. Meth. fung. p. 39, 1797) under the name *Puccinia Polygoni*. This name, though given to the teleutospores, is unfortunately invalid, because it is, so to speak, "pre-Linnaean." In his Synopsis, Persoon (p. 227) changed the name of this fungus to *Puccinia Polygoni aviculariae*. The combination *Uromyces Polygoni* made by Winter (t.c. p. 154, 1881) cannot therefore stand and this well-known name should be replaced by *Uromyces Polygoni-avicularis*.

PUCCINIA HYSTERIUM. Another well-known name which seems to be untenable on different grounds is *Puccinia Tragopogonis* Corda (Icones V. 50, 1842). Persoon described the aecidium stage in Syn. p. 211 as *Aecidium Tragopogi*. Winter t.c. p. 209 (1884) accepted this specific name, and his combination *Puccinia Tragopogi* is perhaps more commonly used than *P. Tragopogonis*, and it is, in error, often attributed to Corda. Röhling, Deutschlands Flora 1813, gives the genus *Puccinia* and then numbers the species giving a description of each and their synonomy. Number 9 (III. p. 131) is described, its host given as "Blätt. des Wiesen=Bocksbart" and *Uredo hysterium*

Strauss in Wetter. Annal II. p. 102 as a synonym. In the index, p. 392, the combination *Puccinia hysterium* is made, a reference being given to the species number. It is certain what species is intended.

PUCCINIA CALTHAECOLA. Schroeter in Cohn's Beitr. z. Biol. Pflan. p. 61 (1879) distinguishes between two species of *Puccinia* growing on *Caltha palustris*. He describes them under the names *Puccinia calthaecola* and *P. elongata* and indicates that he does not know which of the two is the true *P. Calthae* of Link, remarking that only by examination of Link's original specimens could the question be solved. Winter in Hedwigia 1880, p. 39, states that he has examined these through the kindness of Professor Zopf, and finds that they correspond with *P. elongata* Schroet. He agreed with Schroeter after examining his *P. calthaecola* that it was distinct but "kann wohl kaum ihren Namen behalten, da dies zu häufigen Verwechslungen Veranlassung geben würde; übrigens ist der Name wohl von vornherein als interimistisch gegeben zu betrachten. Ich erlaube mir für diese Art den Namen *Puccinia Zopfii* vorzuschlegen"—! Even such ingenious reasons seem insufficient for refusing the name *P. calthaecola.*

PUCCINIA ANEMONES. In Gmelin's Systema Naturae. 1791, p. 1472, Persoon diagnoses his genus *Aecidium*. On p. 1473 we find "fuscum 14, Aec. seminibus fuscis Persoon." There is no host plant given and there is apparently no way of at present telling what fungus he had in mind, the fact that it is in the second group "cortice distincto orbato, seminibus sub epidermide effusis" being of little assistance. Relhan Fl. Cantabr. Suppl. II. 1793 has an *Aecidium fuscum* recorded on *Anemone nemorosa*, *Carduus arvensis* etc. It seems to be usually assumed that the *Aecidium fuscum* of Relhan is the same fungus as the *A. fuscum* of Persoon (Cf. e.g. Sydow p. 530, Grove p. 215). This was, however, apparently not the opinion of Persoon himself. Commenting on a translation of a paper of Richard Pulteney on *Lycoperdon Anemones** he says, "Uebrigens habe ich diese Art schon vor der Erscheinung der Transactions dem Herrn Hofrath Gmelin zu der neuen Ausgabe des Linneischen Natursystems unter dem Namen: *Aecidium Anemones* mitgetheilt. Das von Hrn. Relhan (Suplem. 3tum Fl. cantabrig.) hierhin gerechnete *Aecidium fuscum*, ist eine ganz andere Art, und vermuthlich eine *Uredo*" (Usteri's Ann. Bot. 19, p. 43 (1796)). He seems to have dropped his own *Aecidium fuscum* altogether. In his Observat. Myc. II. p. 24 (1797) he describes *Puccinia Anemones* and gives figures of the teleutospores, giving

* Cf. Trans. Brit. Mycol. Soc. IV., p. 80 (1913).

Aecidium fuscum Relh. no. 1199 and Sowerby Engl. Fungi t. 53 as synonyms. In his Synopsis, p. 226, he again uses this name for the teleutospores on *Anemone nemorosa*, and therefore it must stand instead of *Puccinia fusca*.

PUCCINIA ANOMALA. This fungus was first described by Körnicke (Land-u. Forstw. Ztg. No. 50, 1865) as *P. straminis* var. *simplex*, and it was formerly usually known as *P. Rubigo-vera* var. *simplex* (Cf. Sacc. Syll. VII., p. 625). In 1870 Otth. in Mitth. Nat. Gesell. Bern., p. 114, gave the name *P. Hordei* to this fungus. (It was also independently called *Uromyces Hordei* by Nielsen, 1874.) Fuckel had, however, already bestowed the name *P. Hordei* (Symb. Mycol. App. 2, p. 16, 1873) on a fungus on *Hordeum murinum* which Eriksson and Henning think is probably *P. glumarum*. The name now generally used is the *P. simplex* of these authors (Zeit. f. Pflanzenkr. IV., p. 259, 1894), but this name is already occupied by a fungus on "living leaves of what was apparently some species of Geum" (Peck 34th Report, State Mus. N.Y., p. 41, 1881). It is also predated by Rostrup's name *P. anomala* in Thümen Mycol. Univ. n. 831 (1877), which name is not liable to cause confusion.

OCHROPSORA ARIAE Nov. comb. The teleutospore stage of the fungus generally known as *Ochropsora Sorbi* seems to have been first described by Fuckel (Symbol. Mycol. p. 45, 1869) under the name *Melampsora Ariae*. The description of the teleutospores is wrong in that they are described as "fuscis." From the account of the uredospores, the host plant and the specimens in Fuckel's Fung. Rhen. No. 2219, there can be no doubt, however, as to the fungus intended. (The specific name appears in Schleicher's Cat. Pl. Helv. 1815, but the *Uredo Ariae* is a *nomen nudum*. Secretan, Mycographie III., p. 497 (1833), has a description of a fungus on *Pyrus Aria* under the same name and mentions Schleicher's Catalogue. It is put in the section "espèces noires" and the description mentions "grains noir-purpurin" and "couleur purpurin noirâtre," which seems rather remarkable for the species in question.) The uredospore stage was again described by Oudeman (Nederl. Kruidk. Archief 2, I., p. 177, 1871) as *Caeoma Sorbi*. Three years later Rostrup found the teleutospores on *Sorbus Aucuparia* and described and figured them in Tidsskr. f. Skovbr. II., p. 153 (1877) as *Melampsora pallida*.* When Dietel proposed the genus *Ochropsora* (Ber. Deutsch. Bot. Gesell. XIII., p. 401, 1895) he took Oudeman's specific name. Lind (Danish Fungi as represented in the herbarium of E. Rostrup, 1913) proposes the combination *Ochropsora pallida* as Oudeman's name referred only

* See Just's Botanischer Jahresberichte, 1877, p. 131 (1879).

to the uredospore stage. It would seem, however, that this combination should be replaced by *Ochropsora Ariae*.

The teleutospores of this fungus have not yet been found in this country. Through the kindness of Mr. Carleton Rea and Mr. N. Hadden I obtained a quantity of the aecidium stage on *Anemone nemorosa* in 1912. Mr. Hales, of the Chelsea Physic Garden grew this for me in pots, and the leaves of 1913 were covered with the fungus. Attempts were made to inoculate *Pyrus Aucuparia* and *Spiraea Aruncus*, but were unsuccessful. Mr. Hadden also kept a look out for the teleutospore stage on *Pyrus Aria* growing in the wood in which we obtained the aecidium: none were seen. During the present season it is hoped to investigate the method of infection of the *Anemone* and also to repeat the experiments under more favourable conditions.

Persoon (Syn. p. 212 (1801) and in Gmelin Syst. Nat. p. 1473 (1791) etc.) gives the name *Aecidium Anemones* to the aecidial stage of the fungus. (He clearly distinguishes between this, and *Aecidium punctatum* on *Anemone Ranunculoides*). It seems inadvisable to take up this name in preference to *Aecidium leucospermum* DC. (Flor. fr. II. 239, 1805) as it is certain to cause confusion with *Puccinia Anemones* (supra) if adopted. Persoon had, of course, no idea of suggesting any relationship between these two fungi, regarding his three genera, *Aecidium*, *Uredo* and *Puccinia* as absolutely distinct.

PHRAGMIDIUM. An amazing mass of synonomy meets one when considering what names should be applied to the two fungi, the teleutospores of which seem to have been first described by Tode, Fungi Mecklenburg. Selecti Fasc. I (1790), p. 16, as varieties of *Ascophora disciflora*. The var. α. *solida* infects *Rosa alba* (Tab. III. f. 26) and the var. β *byssina* "In superficie aversa foliorum Rubi idaci" (Tab. III. f. 27). The name of the host is doubtlessly intended for *Rubus idaeus*. The figures show that Tode had seen the teleutospores. His names, however, cannot hold, as they antedate Persoon's Synopsis. The name *Phragmidium disciflorum* which has been proposed by James and accepted by several authors, should therefore be dropped. First considering the variety α. The uredospores of this species were given the name *Lycoperdon subcorticinum* in Hoppe's Botanisches Taschenbuch, p. 68 (1793), and their host plant as "Rosenstrauches." This name* is invalid in that it is given to an imperfect stage and is also prior to Persoon's Synopsis. In the Synopsis, p. 230 (also Disp. meth. fung. p. 38, 1797) Persoon has a species *Puccinia mucronata* which has apparently the same limits as *Ascophora disciflora*. There are two sub-

* *Phragmidium subcorticium* Wint. *P. subcorticatum* Plowr.

species, *α. Puccinia Rosae*, on *Rosa centifolia* and *R. alba* and *β. Puccinia Rubi* on *Rubus fruticosus* especially, rarely on *R. idaeus*. The specific name *mucronata* was taken up by Fries (Observationes Mycologicae I. p. 225, 1815) for Persoon's subspecies *Puccinia Rosae*, which latter name had been used as a specific name by Schumacher (Enumeratio Plant. Snell II., p. 235, 1803) and also by De Candolle. It would seem that Fries' old specific name, so familiar in the old English floras should be adopted. The combination *Phragmidium mucronatum* was made by Schlechtendal, Fl. Berol. II. p. 156 (1824).

There are certain difficulties which arise in connection with Persoon's second subspecies, *Puccinia Rubi*. Sowerby, in his English Fungi, Vol. III., p. 387, tab. CD, fig. 9 (1803) has a popular description of a fungus "very common in autumn on the leaves of brambles. It is also not uncommon on the foliage of some of the *Rosae*." The figure shows a bramble leaf, and also some teleutospores. In the same year Schumacher l.c. has a description of *Puccinia Rubi* growing on *Rubus idaeus*. Of these two descriptions it seems logical to take Schumacher's, seeing that Sowerby's includes several species. The former doubtless intended his two species *Puccinia Rosae* and *P. Rubi* to represent the two subspecies of Persoon. He does not give a reference to Persoon, but that was not at all unusual in the older Floras. The var. *β byssina* of Tode was on *Rubus idaeus* (supra). The *P. Rubi* of Schumacher has only this plant mentioned as a host. (Persoon's *P. Rubi* is on *Rubus fruticosus*, rarely on *R. idaeus*.) The *Phragmidium* on *Rubus idaeus* has of course received the name *Puccinia Rubi-idaei* DC. Fl. fr. VI. p. 54 (1815)—*Phragmidium Rubi-idaei* (DC.) Karst. in Myc. Fenn. IV., p. 52 (1878). (Persoon also had the uredostage separated—*Uredo Rubi-idaei* (Syn. p. 218)). There seems no way out of accepting Schumacher's *Puccinia Rubi* as the name for the *Phragmidium* on *Rubus idaeus*. It seems illogical to extend the list of host plants to include other species of *Rubus* and then to exclude *R. idaeus*. If the name be not accepted in this sense then *Phragmidium Rubi-idaei* (DC.) Karst. should be taken.

For the other species the trouble is that there is the danger of confusing it with *Phragmidium violaceum* (*Puccinia violacea* Schulz. Prodrom. Fl. Starg., p. 459, 1806). *Phragmidium bulbosum*, formerly used, cannot hold as the first description of the teleutospores, *Uredo bulbosa*, Strauss in Welt. Gesell. Ann. II., p. 108 (1810), refers to the "septulis constanter quatuor" and is therefore *P. violaceum*. (Fries Obs. p. 226 used the specific name in his species *Aregma bulbosum* "In *Rubo idaeo* aliisque.") Another name formerly used, *Phragmidium incrassatum*, was proposed by Link Sp. Plant VI. ii. p. 85 (1825), and

was used by him in the same sense that *Puccinia mucronata* was used by Persoon:—*Phragmidium incrassatum:* var. 1. *Mucronatum*, var. 2. *Bulbosum.* Fuckel Symb. Mycol. p. 47 (1869) uses the name *P. incrassatum* for var. 2. He attributes this to Tulasne and gives a reference to Ann. Sci. Nat. 4 II. (1854). No page is given. The same reference is given in Sydow with the addition of the page at which the paper commences. I cannot find *P. incrassatum* used in this restricted sense in any of Tulasne's writings. If the name was first given in this narrowed sense by Fuckel, it is predated by *P. cylindricum* Bon. Coniom. p. 60 (1860). Thus, it seems that the names *Phragmidium Rubi*, *P. Rubi-idaei* and *P. subcorticium* of the list, should be altered to *P. cylindricum*, *P. Rubi* and *P. mucronatum* respectively.

I wish to express my indebtedness to Dr. Rendle and Mr. Gepp for their kind assistance in points of nomenclature.

ON THE IDENTITY OF CORTICIUM POROSUM BERK. ET CURT.

By E. M. Wakefield, F.L.S.

In the Annals and Magazine of Natural History, ser. V., Vol. 3 (1879) p. 211, there appeared in "Notices of British Fungi" by Berkeley and Broome, the description of a species of Corticium, in the following words:—

"*Corticium porosum*, Berk. and Curt. MSS. Resupinatum lacteum, hic illic porosum; margine libero reflexo.

Aboyne. Apparently the same with specimens from Venezuela. The pores look as if little dew-drops had settled on the hymenium, which had in consequence contracted or, rather, retracted."

In the *C. porosum* cover at Kew, where Berkeley's herbarium is preserved, there are but two specimens which belonged to him. One of these is labelled in his handwriting "*C. porosum*, B. and C., 203, Venezuela." The other has no name, and bears only the locality "Glamis." There exists no specimen from Aboyne, which is in Aberdeenshire, whilst Glamis is in Forfarshire. The two specimens prove to belong to different species, hence there arises a difficulty as to nomenclature.

The Glamis specimen, in spite of the discrepancy as to locality, corresponds exactly with Berkeley's description of the appearance of the hymenium, and seems undoubtedly to be the plant he had in mind when drawing up the description. The Venezuela specimen is cracked irregularly into very minute areas, but has not the same appearance of shallow pores. Hence if the name *porosum* is retained, it seems justifiable to regard the Glamis specimen as authentic, even if it is not the actual type of his species.*

Microscopic examination shows, however, that this plant is identical with a species which Bresadola, in Brinkmann's Westfälische Pilze, No. 18, and in Hedwigia, Vol. 39 (1900), p. 221, named *Corticium (Gloeocystidium) stramineum*. When in perfect condition the plant is quite smooth, or with the hymenium only slightly interrupted towards the edge. The "pores" in Berkeley's specimen appear to be merely accidental (as

* It is possible that Berkeley's citation of "Aboyne" in his description was an error, and that Glamis was the correct locality.

is also the reflexed margin), and might well be caused in the way he suggests, as the tissue of the fungus is composed of very closely agglutinated hyphae with abundant "gloeocystidia," and approaches a mucilaginous or gelatinous consistency. Berkeley's name is inapt, and the species is not recognisable from the description; yet regarding the Glamis specimen as authentic (as in view of its agreement with the description it undoubtedly is) according to rules of priority the name *C. porosum* must be adopted for this species, and *C. stramineum* Bres. regarded as a synonym.

The plant is well characterised by its close tissue, with abundant, rather short, tapering "gloeocystidia," which in old specimens sometimes occur in superimposed layers. They are about 10-15μ wide at the base, gradually tapering to an obtuse narrow apex. The spores are elliptical, usually guttulate, and $4\text{-}5 \times 2\text{-}2\frac{1}{2}\mu$, and the wall becomes deep violet-blue on the application of iodine, as was noted by Bourdot and Galzin (1912).

The plant seems to be rare in Britain, the only specimens I have received having been collected by Mr. W. B. Grove at Earlswood and Studley Castle, Warwickshire.

A LIST OF THE BRITISH SPECIES OF DISCOMYCETES ARRANGED ACCORDING TO BOUDIER'S SYSTEM, WITH A KEY TO THE GENERA.

By J. Ramsbottom, M.A., F.L.S.

In compiling a list of the British Discomycetes it was considered advisable to adopt the arrangement given by Boudier in his "Histoire et Classification des Discomycètes D'Europe (1907)." To assist those who wish to use the list, the genus under which Massee (British Fungus Flora IV.) places the species is indicated. Where the species is included under another species in Massee, the name of the latter is given in brackets. Names in italics indicate that the species is not given in Boudier's list: the names of such species which are included by Massee are in square brackets; those which are not in Massee's book, and concerning which M. Boudier has not expressed an opinion, are given in round brackets. In compiling the key to the genera, I have received great assistance from a paper by Boudier, "Nouvelle classification naturelle des Discomycètes charnus," Bull. Soc. Mycol. France I., p. 91, 1885. I have to thank our honorary member, Mons. E. Boudier, for his great kindness in answering several queries. I also wish to thank our honorary secretary, Mr. Carleton Rea, for valuable suggestions and criticisms.

It should be noted that *pro parte* should be added after the names of authors in almost all cases.

DISCOMYCETES.

Receptacle disciform, having the hymenium spread out on the upper surface in a distinct thin membrane intimately associated with it and following all its undulations, generally cup-shaped, closed at first, soon opening and expanding with growth and often becoming finally convex, sessile or stipitate, generally simple, regular, sinuate or strongly lobed, sometimes compound, that is, having several hymenia on the receptacle.

Ascus dehiscing by a circular opening at the apex, furnished with a lid *(operculum)* either bending backwards, or more or less closing the opening: more rarely dehiscing by a bilabiate aperture .... **OPERCULEAE**

Ascus dehiscing by a simple orifice *(foramen)* at the apex **INOPERCULEAE** (p. 370)

OPERCULEAE.

Margin of the receptacle enclosing the hymenium **Operculeae marginatae**

Margin of the receptacle, if any, not enclosing the hymenium **Operculeae immarginatae** (p. 350)

Operculeae marginatae.

Several distinct hymenia on a receptacle ...... § **COMPOUND**

A single hymenium on each receptacle .... § **SIMPLE**

§ COMPOUND.

Receptacles stipitate having distinct alveolar hymenia, separated by sterile flanks or ribs .... **Morchellaceae**

Morchellaceae.

Pileus adnate to the stem throughout *(Adnatae)* or slightly separated at the base by a circular groove *(Distantes)* *Morchella* (1)*

Pileus not adnate to the stem throughout but always separated from it by at least half its height .... *Mitrophora* (2)

§ SIMPLE.

Receptacles always more or less stipitate; pileus campanulate, regular, or lobed, having the margin edges reflexed in the form of a hood, mitre or saddle .... **Mitreae**

Receptacles stipitate or sessile, always concave when young but often becoming spread out or even convex when old, almost always thin in comparison with their size; asci cylindrical and relatively narrow ... **Cupuleae** (p. 345)

Receptacles almost always sessile, thick and lenticular, cupular only at first, becoming hemispherical then convex or pulvinate; asci usually relatively broad **Lenticuleae** (p. 348)

Mitreae.

Stem cartilaginous and often grooved .... HELVELLACEAE

HELVELLACEAE.

Pileus little or not lobed, reflexed in the form of a hood,

* Number of genus in list of species.

attached by its centre to a long stem; spores without guttulae but having external protoplasmic granulations at each end .... **Verpeae**

Pileus more or less divided or lobed and bent, more rarely regular, generally stipitate in the form of a mitre or saddle; spores always with one or more oleaginous guttulae **Helvelleae**

Verpeae.

Hymenium not, or scarcely wrinkled; spores 8 in ascus *Verpa* (3)

Helvelleae.

Receptacle more or less ovoid, conical and little lobed, with edges applied to, and often united with a short and stout stem; hymenium strongly veined and more or less undulate; spores fusiform, apiculate at both ends, usually with three guttulae .... *Gyromitra* (4)

Receptacle bent on the stem from several sides, entire or deeply lobed with edges free or joined in places to the stem.

Spores elliptical with a large central oil guttula accompanied or not by other granulations.

Receptacle freely lobed; stem relatively thick; grooved *(Sulcipedes)* or smooth *(Laevipedes)* *Helvella* (6)

Receptacle entire or hardly lobed, more saddle-like, stem relatively slender; smooth *(Laevipedes)* or villose *(Villipedes)* .... *Leptopodia* (7)

Spores elliptical or fusiform without a central guttula but with 1-2 smaller guttulae at the extremities, rarely divided .... *Physomitra* (5)

Cupuleae.

Receptacle usually fairly large and terrestrial ... PEZIZACEAE

PEZIZACEAE.

Receptacles flattened not cupular.

Receptacles expanded from the first, furnished on lower surface with root-like strands of mycelium **Rhizineae** (p. 346)

Receptacles soon becoming expanded, without root-like strands of mycelium, sessile; asci not turning blue with iodine .... **Discineae** (p. 346)

Receptacles cupular or ear-shaped.

Asci turning blue at the apex with iodine.

Receptacle always more or less furfuraceous, especially towards the margin, sometimes slightly tomentose .... **Aleurieae** (p. 346)

Asci not turning blue with iodine.

Receptacles generally stipitate or subsessile, usually veined below, the veins terminating on the stem **Acetabuleae**

Receptacles cupuliform, regular or laterally split, finely furfuraceous or tomentose; hymenium of various colours, sometimes black .... **Pezizeae** (347)

Receptacle cupular, externally covered with hairs, usually longer and more numerous towards the margin; hymenium never black .... **Lachneae** (347)

Acetabuleae.

Spores obtusely elliptical having a large central guttula and usually granules at each extremity.

Stem long, slender, ordinarily not grooved or slightly lacunose. (Differs from *Leptopodia* in being always cupular) .... *Cyathipodia* (8)

Stem, when present, generally thick and grooved *Acetabula* (9)

Spores navicular or subfusiform, often finely verrucose when mature, containing several oleaginous guttulae; pedicel long and slender ...... *Macropodia* (10)

Rhizineae.

Paraphyses covered with an epithecial agglutination breaking up into narrow strips .... *Rhizina* (11)

Discineae.

Spores fusiform, guttulate, with pointed or truncate appendages at each end .... *Discina* (12)

Spores elliptical, eguttulate, often with external granulations at each end .... *Disciotis* (13)

Aleurieae.

Spores elliptical.

Spores with neither guttulae nor oily granulations; receptacle usually sessile or nearly so, cupuliform, more or less furfuraceous .... *Aleuria* (14)

Spores with two guttulae, accompnaied or not by granulations.

Receptacle from the first terrestrial and open.

Receptacle cupuliform, furfuraceous, more or less lactescent .... *Galactinia* (15)

Receptacle always thick, rather spread out in the larger species, cushion-shaped in the smaller ones *Pachyella* (18)

Receptacle at first subterranean and closed, opening afterwards in a star-like manner and becoming semi-emergent .... *Sarcosphaera* (16)

Spores round; receptacle first cupular then flattened *Plicaria* (17)

Pezizeae.

Asci of medium size.

Receptacle more or less ear-shaped, rarely entire.

Receptacle ear-shaped, cartilaginous; paraphyses straight; spores with a central guttula ... *Wynnella* (19)

Receptacle ear-shaped, furfuraceous; paraphyses with granular contents, often curved at the apex; spores with two guttulae .... *Otidea* (20)

Receptacle cupular and not split at the side, otherwise as in *Otidea* except that the paraphyses are frequently straight, and the spores verrucose *Pseudotis* (21)

Receptacle entire, rarely incised.

Paraphyses slender and colourless or nearly so, hardly thickened at the apex.

Spores with oleaginous guttulae usually two in number, and granulations .... *Pustularia* (22)

Spores without guttulae .... *Geopyxis* (23)

Paraphyses coloured, generally clavate at the apex, contents colouring green with iodine ... *Peziza* (24)

Asci long and slender; paraphyses often very branched.

Hymenium usually of a scarlet red; branches of paraphyses pointed .... *Sarcoscypha* (25)

Hymenium black, rarely olive.

Receptacle stipitate or substipitate; stem covered with black or brown fibrils; spores elongate-elliptic *Urnula* (26)

Receptacle sessile, covered externally with septate, elongate and undulate (or even spiral) hairs; spores round, often appearing falsely septate *Pseudoplectania* (27)

Lachneae.

Hairs white; spores usually verrucose, with two large oleaginous guttulae .... *Leucoscypha* (28)

Hairs brown, rigid or flexuose.

Hairs rigid, attenuated into a point at the apex, short, longer towards the margin.

Spores without guttulae or having small granulations, epispore usually smooth .... *Tricharia* (29)

Spores usually with two guttulae with or without smaller granulations, epispore usually verrucose *Lachnea* (30)

Hairs flexuose or contorted, generally very long and not pointed, receptacle at first subterranean and completely closed, then exposed, cupular, star-shaped .... *Sepultaria* (31)

Lenticuleae.

Ripe asci scarcely projecting from the surface of the hymenium; spores often guttulate, never coloured; protoplasmic contents of the paraphyses turning green with iodine .... HUMARIACEAE

Ripe asci projecting from the surface of the hymenium, causing it to appear more or less warted or papillate; spores without guttulae, often coloured ASCOBOLACEAE (p. 349

HUMARIACEAE.

Receptacle covered externally or at the margin with pointed hairs generally of a brown or tawny colour; hymenium of various colours .... Ciliarieae

Receptacle tomentose, glabrous or furfuraceous, almost always yellow orange in colour .... Humarieae (p. 349

Ciliarieae.

Hairs of receptacle long and pointed; spores usually guttulate.

Hymenium whitish or cinereous; hairs brown; paraphyses clavate at the apex .... *Trichophaea* (32)

Hymenium brownish, furnished with black hairs similar to those of the exterior; paraphyses divided at the apex into a fascicle of brown hairs. (On pine leaves) .... *Desmazierella* (33)

Hymenium red or yellow, rarely tawny or pink.

Spores guttulate.

Spores oval or round, containing numerous oleaginous granules; receptacles covered externally with brown hairs; hymenium usually carmine red; generally terrestrial .... *Ciliaria* (34)

Spores elliptical; hairs of receptacle colourless; hymenium usually yellowish; growing amongst mosses .... *Neotiella* (36)

Spores eguttulate, elliptical; hairs of receptacle few and pale coloured; hymenium usually yellowish; often fimicolous .... *Cheilymenia* (35)

Hairs of receptacle short and obtuse; spores with or without guttulae.

Spores continuous.
Spores guttulate.
Spores reticulate or verrucose; receptacle red, terrestrial *Melastiza* (37)
Spores smooth; receptacle orange, carbonicolous *Anthracobia* (38)
Spores eguttulate; receptacle pale, shortly stipitate *Pseudombrophila* (39)
Spores uniseptate, oblong, cylindrical, often slightly curved; paraphyses linear. (Appearance recalling that of *Lachnella*) .... *Perrotia* (40)

Humarieae.

Receptacle externally floccose, very rarely smooth; paraphyses usually with clavate tips.
Spores guttulate.
Spores elliptical or subfusiform, usually smooth, rarely verrucose or reticulate .... *Humaria* (41)
Spores round.
Receptacle yellow or orange coloured; paraphyses clavate; spores verrucose, rarely smooth *Lamprospora* (42)
Receptacle whitish, hymenium yellowish-orange; paraphyses very slender; spores smooth; growing on conifers .... *Pithya* (43)
Spores eguttulate, smooth, elliptical; receptacle furfuraceous, growing on dung .... *Coprobia* (44)
Receptacles externally smooth; paraphyses very slender and branched, apex curved, not clavate; spores round and filled with oleaginous granules *Pulvinula* (45)

ASCOBOLACEAE.

Spores usually violet becoming brown or brownish with age; ripe asci projecting from the hymenium, making it appear under a lens papillate with black points or warts **Ascoboleae**
Spores colourless or nearly so; ripe asci usually projecting from the hymenium, which appears papillate and of one colour .... **Pseudo-Ascoboleae** (p. 350)

Ascoboleae.

Spores violet becoming brown.
Spores not aggregated in a cluster and not surrounded by a special membrane within the ascus.
Spores elliptical, dark coloured.
Receptacle externally glabrous or furfuraceous *Ascobolus* (46)

Receptacle externally hairy .... *Dasyobolus* (47)
Spores perfectly round, sometimes pale in colour *Sphaeridiobolus* (48)
Spores aggregated in a cluster and surrounded by a special membrane within the ascus ... *Saccobolus* (49)
Spores when mature slightly brownish, internally granulose, covered with a very raised network forming regular alveoles; receptacles rounded then pulvinate, immarginate .... *Boudiera* (50)

Pseudo-Ascoboleae.

Spores round; paraphyses fairly thick, septate, and somewhat jointed; margin of receptacle more or less dentate .... *Cubonia* (51)
Spores elliptical or fusiform.
Asci projecting prominently from the hymenium; spores numerous .... *Thecotheus* (52)
Asci slightly projecting beyond the hymenium.
Asci many.
Asci containing eight, rarely sixteen, spores.
Receptacle externally glabrous or slightly furfuraceous .... *Ascophanus* (53)
Receptacle externally hairy ...... *Lasiobolus* (54)
Asci containing numerous spores; usually very wide.
Receptacle brownish or reddish in colour; ascus dehiscing operculately .... *Rhyparobius* (55)
Receptacle white or coloured otherwise than brown or red; ascus dehiscing by a bilabiate aperture *Ascozonus* (56)
Ascus one, oval, containing several hundred spores, apex projecting prominently from the hymenium *Thelebolus* (57)

Operculeae immarginatae.

Receptacle present or absent, never cupuliform but more or less flattened or convex; ascus dehiscing operculately; carbonicolous, terrestrial or saprophytic **Pyronemaceae**
Receptacle inconspicuous; ascus dehiscing by a bilabiate aperture; true parasites .... **Exoasceae**

Pyronemaceae.

Spores colourless, oval, without guttulae; paraphyses slender; receptacles at first separate then confluent in more or less extended plates; not fimicolous .... *Pyronema* (58)
Spores brown or yellowish, round or ovoid, granular or strongly

reticulate; paraphyses rare or none; receptacle wanting; asci arising in fascicles on the mycelium; fimicolous *Ascodesmis* (59)

Exoasceae.

Asci generally octosporous, and usually provided with a basal cell .... *Exoascus* (61)

Asci generally polysporous, rarely having a basal cell *Taphrina* (60)

INOPERCULEAE.

Margin of the receptacle enclosing the hymenium **Inoperculeae marginatae**

Margin of the receptacle, if any, not enclosing the hymenium (No British species yet recorded) **Inoperculeae immarginatae**

Inoperculeae marginatae.

Receptacles of a waxy or gelatinous consistency, always superficial .... § **FLESHY**

Receptacles of a cartilaginous (or at least firm) consistency, free, caespitose or incrusted § **CARTILAGINOUS** (p. 357)

§ FLESHY.

Receptacle stipitate, rarely sessile, elongate-clavate or orbicular; hymenium covering the club and adnate to the stem, or only separated by a groove .... **Clavuleae**

Receptacle sessile, rarely stipitate, at first truncate, then plane or convex, rarely slightly cupular, always thick relative to its size .... **Spisseae** (p. 353)

Receptacle often stipitate, at first distinctly cupular, becoming plane, afterwards flattening, usually thin relative to its size .... **Cyathuleae** (p. 354)

Clavuleae.

Stem dilating imperceptibly into an elongated club, more rarely rounded; club covered with the hymenium and not separated from the stem by a groove; terrestrial **GEOGLOSSACEAE**

Stem dilating imperceptibly or brusquely into a less elongated often rounded club; the hymenium on the club separated from the stipe where this is present, by a more or less marked groove; generally epiphytal, rarely terrestrial **LEOTIACEAE**

GEOGLOSSACEAE.

Spores brown or olivaceous, usually multiseptate.
  Hymenium hairy .... *Trichoglossum* (62)
  Hymenium smooth, and sometimes viscous
  Geoglossum (63)

Spores hyaline.
  Spores septate .... *Leptoglossum* (64)
  Spores continuous .... *Microglossum* (65)

LEOTIACEAE.

Hymenium never pulverulent nor floccose even when dry.
  Spores claviform or fusiform.
    Spores claviform, very elongate, internally granular, finally septate; paraphyses slender, branched, curved at the apex; club more or less undulate, often flattened .... *Spathularia* (66)
    Spores linear-claviform, with granulations or small guttulae; paraphyses slender, curved at the apex; head rounded, more or less lobed
    Cudonia (69)
    Spores subfusiform becoming finally uniseptate; paraphyses straight, not branched, or divided only at the base, filled with oil globules; head rounded
    Cudoniella (70)
  Spores oblong.
    Spores oblong, eguttulate, continuous or finally uniseptate; groove between hymenium and stipe indistinct
    Mitrula (67)
    Spores oblong-fusiform, guttulate when young, continuous or finally septate; groove between hymenium and stipe very distinct .... *Leotia* (68)

Hymenium floccose, pulverulent or filamentous.
  Hymenium at first smooth; spores remaining very often attached to the surface of the hymenium during desiccation and making it appear tomentose or hairy; spores filiform; paraphyses slender, terminating in a fascicle of coloured clavate branches.
    Stipitate .... *Vibrissea* (71)
    Sessile .... *Apostemidium* (72)
  Hymenium floccose from the first; paraphyses numerous, slender, undulate, much longer than the asci and retaining the spores; spores small, round and flattened .... *Pilacre* (= *Roesleria*) (73)

Spisseae.

Receptacle stipitate, obconic or turbinate, gelatinous; foramen marginate .... OMBROPHILACEAE

Receptacle stipitate or obconic, gelatinous and elastic, very thick; foramen marginate .... BULGARIACEAE

Receptacle sessile, rarely obconic, brightly coloured, thick; foramen immarginate .... CALLORIACEAE

OMBROPHILACEAE.

Stipitate or turbinate; spores oblong, subfusiform without guttulae or having only granulations *Ombrophila* (74)

Obconic, rarely stipitate; spores with guttulae or granulations.

Growing on wood or decaying plants.

Receptacle very thick, convex, tawny or whitish in colour, rarely yellow .... *Pachydisca* (75)

Receptacle thick and turbinate, a little cupuliform, usually yellow .... *Calycella* (76)

Terrestrial.

Externally subtomentose; hymenium more or less surrounded by a dentate margin *Discinella* (77)

Glabrous or granular with an irregularly dentate, blackish margin .... *Melachroia* (78)

BULGARIACEAE.

Spores hyaline, continuous or septate; receptacle purple or violaceous, rarely green .... *Coryne* (79)

Spores black or olivaceous, continuous.

Receptacle turbinate or substipitate; often only four spores becoming coloured in the ascus *Bulgaria* (80)

Receptacle sessile, expanded; all spores coloured *Bulgariella* (81)

CALLORIACEAE.

Receptacle usually erumpent, glabrous, generally reddish, inconspicuous, consisting principally of asci; paraphyses rare .... *Agyrium* (86)

Receptacle rarely erumpent.

Paraphyses slender, very much branched, very rarely clavate at apex; spores simple or septate.

Hymenium appearing finely tomentose owing to the projection of the paraphyses which are dendroid at their apices and longer than the asci *Polydesmia* (84)

Hymenium smooth; spores oblong or slightly fusiform, at first guttulate, then pluriseptate; receptacle greenish or olivaceous .... *Corynella* (82)

Paraphyses slender or cylindrical, simple, or branched only at the base.

Paraphyses slightly or not thickened at apex.

Spores usually elliptical or slightly fusiform, with a medial wall (rarely more) at maturity; receptacle yellow or reddish, sometimes erumpent *Calloria* (85)

Spores ovoid, fusiform or cylindrical, more or less curved, continuous; receptacle bright in colour and often translucent; margin often dentate *Hyalinia* (89)

Paraphyses thickened at the apex.

Paraphyses slender, lanceolate at the apex; asci clavate; margin of the receptacle distinctly lacerate or dentate .... *Habrostictis* (87)

Paraphyses slender, apex swollen into a knob; asci almost cylindrical; spores often more or less curved .... *Orbilia* (88)

Paraphyses thick, apex clavate; of the same colour as the receptacle; receptacle exceedingly small; growing on *Jungermanniae* ...... *Mniaecia* (83)

Cyathuleae.

Receptacle usually stipitate, glabrous or finely floccose, rarely hairy; ascus with marginate foramen; spores ovoid, very rarely having a medial wall .... **CIBORIACEAE**

Receptacle stipitate or sessile, hairy; ascus with immarginate foramen; spores very variable, usually fusiform-elongate and continuous .... **LACHNELLACEAE** (p. 355)

Receptacle sessile, more or less covered with hairs which are often indistinct; exterior dark, disc lighter; ascus with immarginate or marginate foramen; spores oblong-fusiform, often a little curved, sometimes finally septate **MOLLISIACEAE** (p. 356)

CIBORIACEAE.

Receptacle glabrous or finely furfuraceous, very rarely hairy, very thin and at first deeply cupular; spores continuous, only exceptionally becoming finally septate ...... **Ciborieae**

Receptacle glabrous or often finely puberulent, never hairy; thicker and less deeply cupular; spores generally becoming septate at maturity .... **Helotieae**

Ciborieae.

Stem arising from a sclerotium .... *Sclerotinia* (91)

Stem arising from a stroma enveloping the organs on which it is developed but not differentiated into a sclerotium .... *Stromatinia* (92)

Stem not arising from a sclerotium or stroma ... *Ciboria* (90)

Helotieae.

Receptacle entire at the margin.
Spores more or less oblong or cylindrical, often curved, obtuse at both ends.
Ascus turning distinctly blue with iodine; spores filled with oleaginous granulations, often finally pluriseptate; receptacle fawn, olivaceous or testaceous in colour .... *Phialea* (93)
Foramen of the ascus scarcely tinging blue with iodine; spores with only a few granulations; receptacle green, more or less bluish or yellowish in colour *Chlorosplenium* (94)
Spores more or less fusiform, sometimes curved, having guttulae or granulations near the ends, rarely septate in the middle at maturity *Helotium* (95)

Receptacle dentate at the margin.
Spores continuous.
Teeth of membranous margin wide and obtuse; spores oblong, rounded at both ends, very granular internally .... *Stamnaria* (96)
Teeth of membranous margin pointed and very long; spores elongate-fusiform, scarcely granular.
Receptacle stipitate .... *Cyathicula* (97)
Receptacle sessile .... *Peristomialis* (98)
Spores pluriseptate.
Receptacle light in colour, stipitate *(Podobelonidium)* or sessile *(Eubelonidium)* .... *Belonidium* (99)
Receptacle brownish, almost always sessile *Belonium* (100)

LACHNELLACEAE.

Receptacle stipitate or sessile, exterior covered with fairly long, septate, more or less flexuous hairs, often covered with granules which sometimes disappear; paraphyses acuminate-fusiform; spores elongate or filiform, continuous .... **Dasyscypheae** (p. 356)
Receptacle more or less sessile, less hairy and rather tomentose; paraphyses linear, rarely a little acuminate; spores less elongated, sometimes even round, occasionally septate **Trichoscypheae** (p. 356)
Receptacle very small, sessile or shortly stipitate, campanulate, open only when moist, covered with a short pubescence formed of hairs usually attenuated at the summit, continuous, more rarely septate, with thick walls and usually more or less flexuous; spores oblong, usually continuous **Urceoleae** (p. 356)

Dasyscypheae.

Receptacle hairy.
Receptacle stipitate.
Receptacle stipitate, spores elongate-fusiform *Dasyscypha* (101)
Receptacle sometimes almost sessile, spores very long and filiform .... *Erinella* (103)
Receptacle sessile, spores elongate-fusiform, sometimes a little curved .... *Lachnella* (104)
Receptacle glabrous, stipitate, paraphyses acuminate-fusiform *Hyphoscypha* (102)

Trichoscypheae.

Receptacle stipitate, turbinate, or urceolate.
Spores oval, sometimes quite round; receptacle covered with septate, white, often granular hairs; hymenium orange; usually growing on conifers *Trichoscypha* (105)
Spores round; receptacle tomentose rather than hairy; brightly coloured, muscicolous or growing on the branches of deciduous trees......*Pithyella* (106)
Receptacle sessile.
Receptacle densely hairy, developing on a generally fairly abundant mycelium; spores oblong 1-3 septate *Arachnopeziza* (107)
Receptacles slightly hairy, fairly thick and always a little translucent; spores oblong, often a little claviform, continuous .... *Hyaloscypha* (108)

Urceoleae.

Receptacle stipitate, covered with short hairs; spores oblong or oval, few or no internal granules *Micropodia* (109)
Receptacle sessile rarely stipitate.
Receptacle sessile, clothed on the exterior with short, crowded hairs, attenuated at the summit, walls fairly thick, often united into ribs; asci small, fairly wide; spores oblong or fusiform *Urceolella* (110)
Receptacle sessile, or very rarely substipitate, covered on the exterior with almost colourless, obtuse hairs; asci claviform; spores oblong, often a little curved *Trichopeziza* (111)

MOLLISIACEAE.

Margin usually fimbriate with white or whitish hairs, never membranaceous lacerate.

Receptacle plane not urceolate, margin broad, white or whitish, and having obtuse hairs in parallel rows; externally covered with simple, obtuse, black or very dark hairs ... *Coronellaria* (115)

Receptacle always urceolate when young.

Paraphyses always filled at first with an oily protoplasm which separates later into thick granules; septate only at base, thick, elongate clavate.

Receptacle growing on an abundant mycelium (subiculum) .... *Tapesia* (117)

Receptacle naked at the base or only having a few mycelial hyphae .... *Mollisia* (116)

Paraphyses not having an oily protoplasm.

Receptacles more or less aggregated, growing on a black stromatiform subiculum...*Ephelina* (113)

Receptacles not growing on a subiculum.

Spores uniseptate; receptacles not villose; paraphyses often septate towards the summit *Niptera* (118)

Spores continuous.

Receptacle pubescent, generally black externally, margin whitish; hairs septate, obtuse, blackish, often converging into fascicles or ribs *Pyrenopeziza* (112)

Receptacle pubescent, hairs pointed, septate, sparse and less fasciculate .... *Pirottaea* (114)

Receptacle granular, margin not fimbriate *Mollisiella* (119)

Margin formed by a cellular membrane which tears into irregular teeth; receptacle externally blackish, superficial on a black, elongated, linear stroma; spores irregularly elliptical .... *Spilopodia* (120)

§ CARTILAGINOUS.

Receptacle superficial or erumpent, not incrusted ... **Libreae**

Receptacle buried in the substratum, often coalescing with it, not becoming superficial .... **Incrusteae** (p. 361)

Libreae.

Receptacles firm, scattered, free or becoming so finally, generally blackish, rarely brighter coloured, rarely erumpent and then distinguished by their blackish colour (Superficial.) PATELLARIACEAE (p. 358)

Receptacles firm, caespitose, subcorticular then erumpent, generally yellowish or ferruginous, rarely blackish (Erumpent.) DERMATEACEAE (p. 359)

PATELLARIACEAE.

Spores hyaline or nearly so.
Spores continuous.
Growing on lichens; first innate, then erumpent *Nesolechia* (125)
Not lichenicolous.
Asci octosporous.
Receptacle free from the first.
Receptacle rounded, flattened; paraphyses linear, apex sometimes clavate .... *Patinella* (121)
Receptacle more elongate; paraphyses very few; spores elliptical .... *Placographa* (122)
Receptacle at first erumpent, then becoming free; spores fusiform, more or less elongate.
Margin dentate; paraphyses slightly thickened at the apex .... *Heterosphaeria* (123)
Margin lacerate; paraphyses not thickened at the apex .... *Pseudophacidium* (124)
Asci myriosporous; receptacle sessile, slightly marginate, not always blackish in colour ...... *Biatorella* (140)
Spores uniseptate.
Spores oval or oblong, constricted a little at the septum, often larger at one end; paraphyses slender, branched; lignicolous .... *Melaspilea* (129)
Spores elliptic; paraphyses filiform, apex clavate often coloured; lichenicolous .... *Scutula* (139)
Spores finally multiseptate.
Receptacle at first erumpent, then superficial; spores elongate, rod-shaped, filiform, provided with oil drops which ultimately disappear *Scutularia* (138)
Receptacle free from the first.
Receptacle usually light in colour, rarely blackish, often placed on a discoloured spot; spores acicular *Mycobacidia* (133)
Receptacle usually blackish.
Spores triseptate (rarely 5-7 septate), oblong or claviform; receptacle rounded or elongated, at first closed; lichenicolous or epixylous *Leciographia* (132)
Spores with more than three septa.
Paraphyses branched at the ends, apex clavate, and olivaceous; spores many septate, of various forms, often clavate, filled with oily granules *Lecanidion* (135)

Paraphyses little branched, slender, colourless; spores with fewer septa, oblong or elongate-elliptical, slightly constricted at the septa...*Durella* (134)

Spores muriform, receptacles erumpent.

Receptacle with dentate margin; paraphyses simple or divided at the apex, often internally granulose; number of spores in ascus variable

Blitrydium (136)

Receptacle with entire margin; paraphyses a little thickened at the apex, agglutinate and brownish; sometimes lichenicolous ...... *Triblydaria* (137)

Spores brown or blackish.

Spores continuous.

Spores blackish, oblong, a little constricted in the middle, with two guttulae; receptacle large for family (c. 1 cm. diam.), black; margin yellow-olivaceous

Catinella (130)

Spores brown, ovoid; receptacle black *Lagerheima* (126)

Spores uniseptate.

Lichenicolous; receptacle erumpent; paraphyses very branched above .... *Abrothallus* (127)

Lignicolous; receptacle superficial; paraphyses often thickened at the apex .... *Karschia* (128)

Spores pluriseptate, oblong or fusiform; receptacle superficial, slightly marginate ...... *Patellaria* (131)

DERMATEACEAE.

Spores hyaline or nearly so.

Spores continuous, 4-8 in ascus.

Spores oblong or elliptical.

Receptacles epixylous.

Receptacle urceolate.

Receptacle covered externally with short, septate tuberculose hairs; large, attaining up to 5 mm. in diam., marginate; paraphyses claviform and coloured at the apex; spores widely elliptical, sometimes olivaceous, having two guttulae and very numerous granulations

Velutaria (141)

Receptacle not hairy, usually furfuraceous, caespitose.

Receptacle subcoriaceous, tawny, often furfuraceous, margin disappearing with age; spores oblong, rarely uni- or pluriseptate

Dermatea (143)

Receptacle coriaceous, dark in colour, distinctly furfuraceous, asci with 4-8 oblong spores *Cenangium* (144)

Receptacle very hard, black, with contracted margin, having in the middle a trough which opens only when moist: base of receptacle apparently disappearing, leaving the hymenium naked on a colourless sub-hymenial tissue .... *Laquearia* (148)

Receptacle cupular, pezizoid, thin and leathery, externally furfuraceous; spores oblong *Encoelia* (145)

Receptacles developed under the epidermis of leaves, soon breaking through; epidermis forming a stellate border (no carbonaceous stroma); externally almost black, disc greenish or olivaceous; spores elliptical, with greenish guttulae .... *Trochila* (154)

Spores linear, filiform; receptacle club-shaped or elongate-turbinate, black or blackish, smooth; hymenium paler and slightly concave *Pocillum* (153)

Spores continuous, asci myriosporous (microspores sausage-shaped or oval), or octosporous (macrospores oblong, often slightly curved, continuous or septate) often in the same hymenium; paraphyses clavate at the apex *Tympanis* (147)

Spores uniseptate, oblong or oblong-fusiform; receptacle urceolate, obconic at the base, black or blackish, very leathery; asci with 4, 8 or sometimes 16 spores .... *Cenangella* (149)

Spores finally pluriseptate.

Spores oblong, 6-8 in the ascus, filled with oil guttulae or granulations; receptacle brightly coloured, slightly furfuraceous, turbinate; paraphyses branched dichotomously at the summit, apex clavate .... *Pezicula* (142)

Spores elongate; receptacle black or blackish; paraphyses scarcely or not branched.

Spores acicular with the end thickened; receptacle shortly stipitate, margin raised, more or less lacerated into triangular teeth, disc brighter coloured .... *Scleroderris* (151)

Spores filiform, usually multiseptate, typically linear and colourless, sometimes shorter and very slightly coloured; receptacle turbinate or

sessile, always urceolate, glabrous, margin distinct .... *Godronia* (152)

Spores coloured.

Spores elliptical, continuous. (Like *Encoelia* but less furfuraceous) .... *Phaeangium* (146)

Spores oblong or oblong-fusiform, uniseptate. (As in *Cenangella*, but spores coloured) *Phaeangella* (150)

Incrusteae.

Receptacle incrusted in the matrix and sometimes coalescing with it, opening outwards into a rounded or oblong disc surrounded by the raised edges of the substratum, waxy internally, colour variable (Crustaceo-ceraceae) STICTIDACEAE

Receptacle innate or erumpent from a black stroma, margin either distinct and dentate, or formed by the raised and lacerate edges of the stroma, somewhat carbonaceous, disc paler, waxy...(Carbonaceo-ceraceae) PHACIDIACEAE (p. 362)

STICTIDACEAE.

Spores hyaline, continuous.

Receptacle blackish or dark, elongate, sublinear, often growing on a discoloured spot, incrusted, hysterioid; disc paler; spores oval or oblong often having one or two oil guttulae ...... *Xylographa* (158)

Receptacle brownish or of lighter colour.

Receptacle brownish, disc not projecting, usually oblong, sometimes rounded, whitish, yellowish or greenish; paraphyses linear, a little branched or only toothed at the apex; spores oblong, a little curved, having guttulae at each end *Propolis* (155)

Receptacle ochraceous, orange or reddish, though sometimes darker externally; paraphyses simple, apex slightly thickened; spores oval-oblong, continuous, but often becoming septate at maturity, internally granular; epidermis torn into irregular teeth .... *Ocellaria* (156)

Receptacle ochraceous, more or less reddish; paraphyses simple, linear, apex linear-clavate or lanceolate; spores oblong, guttulae present or absent; epidermis torn in stellate manner or into valves *Naevia* (157)

Spores hyaline, finally septate.

Spores oblong or fusiform.

Ascus cylindrical; receptacle bordered usually by a

slight dentate margin, at first closed, then flattened-urceolate; spores oval-oblong, or oblong *Odontotrema* (161)

Ascus claviform.

Receptacle generally pale in colour, more or less orange, rarely olivaceous or blackish, often rounded, sometimes separating from the matrix; disc pale, slightly marginate; spores fusiform, more or less thickened at one end, usually filled with granulations .... *Cryptodiscus* (159)

Receptacle yellowish or reddish, becoming darker especially at the margin; fissures bordered by a more or less dentate margin; asci containing 2-4 or 8 spores; spores oblong or fusiform, often thickened at one end and slightly curved *Phragmonaevia* (160)

Spores rod-shaped or filiform.

Spores rod-shaped, a little narrowed at the ends, breaking up into very numerous oblong portions at the septa each having two guttulae; paraphyses simple, linear; receptacle roundish, blackish, but often covered with yellowish or whitish furfurations; hymenium blackish *Schizoxylon* (164)

Spores not separating into portions; paraphyses very branched.

Receptacle *Aecidium*-like, deeply innate, border fairly wide, whitish, torn into obtuse reflexed teeth; hymenium yellowish or blackish; spores filiform, linear, often flexuous.

Margin membranaceous, furfuraceous ... *Stictis* (162)

Margin hairy .... *Lasiostictis* (163)

Receptacle innate, throwing back the epidermis in the form of two valves, oblong; disc white or yellow; spores elongated, cylindrical, flexuose or vermiform, ends obtuse; pinicolous *Nemacyclus* (165)

Spores hyaline or slightly brownish, muriform; receptacle fleshy, waxy, plane and oblong, slightly marginate; paraphyses filiform, apex broadly clavate *Melittosporium* (166)

PHACIDIACEAE.

Spores hyaline.

Spores continuous.

Spores oval or oblong.

Blackened epidermis splitting radiately; paraphyses linear, apex slightly thickened *Phacidium* (168)

Blackened epidermis splitting circularly in the form of a lid; paraphyses clavate or lanceolate *Stegia* (171)

Blackened epidermis splitting irregularly.

Receptacle black and carbonaceous; asci generally very large; paraphyses brownish, apex slightly clavate; spores elliptical-ovoid with a large central guttula and filled with smaller granules *Cryptomyces* (167)

Receptacle usually black, sometimes paler; hymenium usually lighter; asci medium sized; spores oval or oblong; epiphyllous ... *Pseudopeziza* (170)

Spores filiform or fusiform, very elongated, often flexuous or circinnate; stroma foliicolous, well-defined and somewhat protuberant, splitting in various ways; paraphyses linear, undulate at the apex *Rhytisma* (179)

Spores finally uniseptate, oblong; receptacle very small, disc whitish, bordered by the radiately torn epidermis; ascus two or eight spored; paraphyses filiform and branched at the summit, apex ovoid-clavate *Schizothyrium* (172)

Spores finally multiseptate.

Spores elliptic or oblong.

Lichenicolous; receptacle rounded, scarcely marginate; ascus having very thick walls, 6-8 spored; spores 2-3 septate; paraphyses branched, often terminating in a claviform knob, agglutinate *Celidium* (174)

Not lichenicolous.

Spores 1-3 septate, oblong, elliptic; receptacle very small, black with a stellate margin; paraphyses branched at apex .... *Sphaeropezia* (173)

Spores 5-8 septate, oblong, sometimes yellow; receptacles rounded or oblong, sometimes deformed; margin subbilabiate, rugose and opening widely; paraphyses slender, branched in clusters at the apex .... *Pseudographis* (176)

Spores linear or elongate-fusiform.

Receptacle hemispherical, depressed, black; epidermis torn radiately; paraphyses simple, apex straight or curved, sometimes clavate *Coccomyces* (175)

Receptacle elongate, more or less flexuose, transverse; spores linear, equal in length to the ascus.

Receptacle relatively large, brownish; hymenium whitish; paraphyses slender, simple, bent at the apex. (On oak) .... *Colpoma* (177)

Receptacle smaller, less elongated, blackish; disc rounded and coloured, sometimes reddish; paraphyses linear .... *Sporomega* (178)

Spores brown, oval-elliptic, 1-septate near the base; ascus 4-spored; paraphyses linear, apex clavate, fuliginous; on leaves of Juniper .... *Keithia* (169)

OPERCULEAE.

I. Morchellaceae.

1. MORCHELLA Dill.
   crassipes Krombh.
   Smithiana Cooke. M. crassipes Pers. var. Smithiana.
   rotunda (Pers.) Boud.
   var. *cinerea* Boud.
   vulgaris (Pers.) Boud.
   conica Pers.
   deliciosa Fr. (M. conica)
   hortensis Boud.
   elata Fr.
2. MITROPHORA Lév.
   hybrida (Sow.) Boud. = M. semilibera Lév.
   [*gigas* Lév.]

II. HELVELLACEAE.

3. VERPA Swartz.
   digitaliformis Pers.
   Krombholzii Corda
   var. rufipes (Phill). V. rufipes.
   [conica Müll] var. Relhani (Sow.) V. Relhani Sow.
4. GYROMITRA Fr
   gigas (Krombh.) Cooke.
   [*Phillipsii* Mass.]
5. PHYSOMITRA Boud.
   infula (Schaeff.) Boud. Helvella.
   esculenta (Pers.) Boud. Gyromitra.
6. HELVELLA Linn.
   crispa (Scop.) Fr.
   lacunosa Afz.
   fusca Gill.
   sulcata Afz. H. lacunosa)
   monachella (Scop.) Fr.
7. LEPTOPODIA Boud.
   elastica (Bull.) Boud. Helvella.
   var. guepinioides (Berk. et Cooke.) H. guepinioides.
   pulla (Holmsk.) Boud. Helvella.
   Klotzschiana (Corda) Boud. Helvella.
   pezizoides (Afz.) Boud. Helvella helvelloides.
   atra (König) Boud. Helvella
   ephippium (Lév.) Boud. Helvella.
   Cookeiana Boud.

III. PEZIZACEAE.

8. CYATHIPODIA Boud.
   bulbosa (Hedw.) Boud.
   corium (Weberb.) Boud.
9. ACETABULA Fuck.
   vulgaris Fuck.
   ancilis (Pers.) Boud. Peziza.
   leucomelas (Pers.) Boud.
   var. Percevalii (Berk. et Cooke) A. Percevalii.
   cribrosa (Grev.) Boud. Peziza.
10. MACROPODIA Fuck.
    macropus (Pers.) Fuck. Helvella.
11. RHIZINA Fr.
    inflata (Schaeff.) Karst.

laevigata Fr. R. inflata var. rhizophora.

12. DISCINA Fr.
perlata Fr. Peziza.

13. DISCIOTIS Boud.
venosa (Pers.) Boud. Peziza.
var. reticulata (Grev.) Boud. P. reticulata

14. ALEURIA (Fr.)
vesiculosa (Bull.) Boud. Peziza.
cerea (Sow.) Gill. P. vesiculosa var. cerea.
var. flavida (Phill.) Boud.
insolita (Cooke) Boud. Geopyxis.
bovina (Phill.) Boud. Humaria.
tectoria (Cooke) Boud. P. ampliata var. tectoria.
ampliata (Pers.) Gill. Peziza.
var. linteicola (Phill. et Plowr.) Boud. Peziza linteicola. Also Geopyxis cocotina var. linteicola.
mellea (Cooke et Plowr.) Boud. Peziza.
repanda (Pers.) Gill. Peziza.
sterigmatizans (Phill.) Boud. Peziza.
viridaria (B. et Br.) Quél. Humaria.
subrepanda (Cooke et Phill) Boud. Peziza.
sepiatra (Cooke) Boud. Peziza.
recedens Boud.
violacea (Pers.) Gill. Humaria.
undata (W. G. Sm.) Boud. Geopyxis.
varia (Hedw.) Boud. (P. repanda Grev.)
muralis (Sow.) Boud. Geopyxis.
micropus (Pers.) Gill. Otidea.
isabellina (W. G. Sm.) Boud. Peziza.
umbrina Boud.
petaloidea (Cooke et Phill.) Boud. Geopyxis.

15. GALACTINIA Cooke
ampelina (Quél.) Boud.
Adae (Sadler) Boud. Peziza.
macrospora (Wallr.) Boud. Humaria.
ionella (Quél.) Boud.
badia (Pers.) Boud. Peziza.
succosa (Berk.) Sacc. Peziza.
pustulata (Hedw.) Boud. Peziza.
lividula Phill.) Boud. Peziza.
pleurota (Phill.) Boud. Otidea
saniosa (Schrad.) Sacc.
indiscreta (Phill. et Plowr.) Boud. Peziza.
brunneo-atra (Desm.) Boud.
Phillipsii (Cooke) Boud. Humaria.

16. SARCOSPHAERA Awd.
coronaria (Jacq.) Boud. Sepultaria.

17. PLICARIA Fuck.
leiocarpa (Curr.) Boud. (Curreyella trachycarpa).
trachycarpa (Curr.) Boud. Curreyella.
radula (B. et Br.) Boud. Curreyella.
Persoonii (Cr.) Boud. (=violascens Cooke) Barlaea violascens.

18. PACHYELLA. Boud.
Barlaeana (Bres.) Boud.
Babingtonii (Berk.) Boud. Rhizina.
depressa (Phill.) Boud. Mollisia (also ? Humaria Oocardii).

19. WYNNELLA Boud.
auricula (Schaeff.) Boud. (=Otidea neglecta).

20. OTIDEA Pers.
onotica (Pers.) Fuck.

leporina (Batsch) Fuck.
grandis (Pers.) Mass.
cochleata (Linn.) Fuck.
bufonia (Pers.) Boud. Peziza.
phlebophora (B. et Br.) Sacc.
alutacea (Pers.) Mass.
? neglecta Mass. = Wynnella auricula.

21. PSEUDOTIS Boud.
apophysata (Cooke et Phill.) Boud. Otidea.
radiculata (Sow.) Boud. Geopyxis.

22. PUSTULARIA Fuck.
catinus (Holmsk.) Fuck. (= albida Gill.)
ochracea Boud. Peziza.
cupularis (Linn.) Fuck. Geopyxis.
patavina (Cooke et Sacc.) Boud.

23. GEOPYXIS Pers.
ammophila (Dur. et Mont.) Sacc
carbonaria (Alb. et Schw.) Sacc
carnea (Cooke et Phill.) Sacc.
majalis (Fr.) Sacc.

24. PEZIZA Dill.
aurantia Pers. Otidea.
luculenta Cooke. Otidea.
cornubiensis Berk. Neotiella.
rhenana Fuck. Otidea aurantia var. stipitata (Sec. Boudier in litt.)
rutilans Fr. Neotiella Polytrichi.
Polytrichi Schum. Humaria rutilans.
vivida Nyl. ? = Polytrichi (Neotiella Polytrichi).
Sowerbyi Cooke. Helotium.
ollaris Fr. Humaria.
luteo-nitens B. et Br. Otidea.
fibrillosa Curr. Otidea.

25. SARCOSCYPHA Fr.
coccinea (Jacq.) Fr. Geopyxis.
[var. *albida* Mass.]
protracta (Fr.) Sacc. Anthopeziza mirabilis.

26. URNULA Fr.
melastoma (Sow.) Boud. Plectania.

27. PSEUDOPLECTANIA Fuck.
nigrella (Pers.) Fuck. Sphaerospora.

28. LEUCOSCYPHA Boud.
nivea (Romell) Boud. Neotiella.
fossulae (Limm.) Boud. Neotiella.

29. TRICHARIA Boud.
gilva Boud.
fimbriata (Quél.) Boud.
cretea (Cooke) Boud. Lachnea.
livida (Schum) Boud. Lachnea.

30. LACHNEA Fr.
hemisphaerica (Wigg.) Gill.
hybrida (Sow.) Phill.
? argillacea (Sow.) ("Excluded.")
[*erinacea* (Schwein.) Sacc.]
(*cinnabarina* (Schwein.) Mass. et Crossl.)

31. SEPULTARIA Fr.
Sumneri (Berk.) Boud. S. Sumneriana
foliacea (Schaeff.) Boud.
sepulta (Fr.) Mass.
geaster (B. et Br.) Boud. (S. sepulta).
arenicola (Lév.) Mass.
var. Bloxami Cooke (S. arenicola).
tenuis (Fuck.) Cooke.

IV. **HUMARIACEAE.**

32. TRICHOPHAEA Boud.
gregaria (Rehm.) Boud. Lachnea.
bulbocrinita (Phill.) Boud. Lachnea.
Woolhopeia (Cooke et Phill.) Boud. Lachnea.
leucothecioides (Rehm) Boud.
sublivida (Sacc. et Speg.) Boud. Lachnea.
albo-spadicea (Grev.) Boud. Lachnea.

33. DESMAZIERELLA Lib.
acicola Lib.

34. CILIARIA Quél.
scutellata (Linn.) Quél. Lachnea.
umbrata (Fr.) Quél. Lachnea.
(var. *pallida* Rehm)
umbrorum (Fr.) Boud. Lachnea.
hirta (Schum.) Boud. Lachnea.
contorta (Mass. et Crossl.) Boud.
hirto-coccinea (Phill. et Plowr.) Boud. Lachnea.
carneo-sanguinea (Fuck.) Boud. Lachnea.
lapidaria (Cooke) Boud. L. hybrida var. lapidaria.
setosa (Nees.) Boud. Lachnea.
crucipila (Cooke et Phill.) Boud. Lachnea.
brunnea (Alb. et Schw.) Boud. Sphaerospora.
vitellina (Pers.) Boud. Lachnea.
trechispora (B. et Br.) Boud. Sphaerospora.
var. *paludicola* Boud.
asperior (Nyl.) Boud. Sphaerospora.
hinnulea (B. et Br.) Boud. Sphaerospora.
confusa (Cooke) Boud. Sphaerospora.
schizospora (Phill.) Boud. Barlaea.
binominata (Mass.) Boud. in litt. Sphaerospora.
Phillipsii (Mass.) Boud. in litt. Sphaerospora.
citrina (Mass. et Crossl) Boud. in litt.

35. CHEILYMENIA Boud.
theleboloides (Alb. et Schw.) Boud. Lachnea.
subhirsuta (Schum.) Boud. (probably only a well-developed form of C. theleboloides.) Humaria.
dalmeniensis (Cooke) Boud. Lachnea.
rubra (Cooke) Boud. Lachnea.
stercorea (Pers.) Boud. Lachnea.
luteopallens (Nyl.) Boud.
coprinaria (Cooke) Boud. Lachnea
(var. *minima* Grove).*
erecta (Sow.) Boud. ("Excluded.")
ascoboloides (Bert.) Boud. in litt. Lachnea.

36. NEOTIELLA Cooke.
microspora Cooke et Mass.

37. MELASTIZA Boud.
miniata (Fuck.) Boud. Barlaea Crouani. (Also Otidea aurantia var. atromarginata (sec. Boud.))
Chateri (W. G. Sm.) Boud. (merely young state of M. miniata) Humaria.

38. ANTHRACOBIA Boud.
melaloma (Alb. et Schw.) Boud. Humaria.
? macrocystis (Cooke) Boud. Humaria.

nitida Boud.
maurilabra (Cooke) Boud. Humaria.

39. PSEUDOMBROPHILA Boud.
? tenuispora (Cooke et Mass.) Boud. (Geopyxis parvispora).
pluvialis (Cooke) Boud. (Humaria domestica).

40. PERROTIA Boud.
flammea (Alb. et Schw.) Boud. Dascyscypha.

41. HUMARIA Fr.
humosa (Fr.) Sacc.
coccinea (Cr.) Quél. (Neotiella corallina).
fusispora (Berk.) Sacc. H. carbonigena var. fusispora
aggregata (B. et Br.) Sacc. H. carbonigena var. aggregata.
Roumegueri (Karst.) Sacc.
var. carnosissima Phill.
convexula (Pers.) Quél.
haemastigma (Cooke) Mass.
Nicholsonii Mass.
semiimmersa (Karst.) Sacc. Sepultaria.
leucoloma (Hedw.) Sacc. Neotiella.
pilifera (Cooke) Sacc.
rubens Boud.
carneola (Saut.) Sacc.
Wrightii (Berk. et Cooke) Boud. Barlaea.

42. LAMPROSPORA de Not.
miniata (Cr.) de Not. Barlaea Crouani
astroidea (Hazsl.) Boud. Barlaea.
Crec'hqueraultii (Cr.) Boud.
modesta (Karst.) Boud.

43. PITHYA Fuck.
Cupressi (Batsch) Rehm.

44. COPROBIA Boud.
granulata (Bull.) Boud. Humaria.

45. PULVINULA Boud.
cinnabarina (Fuck.) Boud. Barlaea.
constellatio (Cooke) Boud. Barlaea.

Doubtful Humariaceae:
lecithina Cooke Helotium.
myrothecioides B. et Br. Rhizina.
[*carbonigena* (Phill.) Sacc.]

v. ASCOBOLACEAE.

46. ASCOBOLUS Pers.
Crouani Boud.
denudatus Fr.
perplexans Mass. et Salm.
stercorarius (Bull.) Schroet. = A. furfuraceus.
aerugineus Fr.
vinosus Berk.
Masseei Sacc. et Syd. = A. marginatus.
viridulus Phill. et Plowr.
asininus Cooke et Mass.
minutus Boud.
glaber Pers.
var. albidus March.
amethystinus Phill. (Humaria Phillipsii).
stictoideus Speg.
Leveillei Boud.
viridis Curr.
atro-fuscus Phill. et Plowr. = viridis Boud. = carbonicola Boud. prob. = carbonarius Karst.
Carletoni Boud.

47. DASYOBOLUS Sacc.
immersus (Pers.) Sacc. Ascobolus.
brunneus (Cooke) Sacc. Ascobolus.
barbatus (Mass. et Crossl.) Sacc. Ascobolus.

48. SPHAERIDIOBOLUS Boud.
Crosslandi Boud.

[hyperboreus (Karst.) Boud.]
var. niveus Quél.
49. SACCOBOLUS Boud.
Kerverni (Cr.) Boud.
violascens Boud.
granulispermus Sopp. et Crossl.
depauperatus (B. et Br.) Rehm.
quadrisporus Mass. et Salm.
neglectus Boud.
obscurus (Cooke) Phill.
caesariatus Renny.
50. BOUDIERA Cooke.
areolata Cooke et Phill. Barlaea.
51. CUBONIA Sacc.
Boudieri (Renny) Sacc.
52. THECOTHEUS Boud.
Pelletieri (Cr.) Boud. Rhyparobius.
53. ASCOPHANUS Boud.
carneus (Pers.) Boud.
var. cuniculi Boud.
saccharinus (Berk. et Curt.) Boud. (A. carneus.)
hepaticus (Batsch) Boud. Humaria.
cervarius (Phill.) Boud. Humaria.
misturae (Phill.) Boud. Humaria.
salmonicolor (B. et Br.) Boud. Humaria.
testaceus (Moug.) Phill. A. carneus var. testaceus.
deerratus (Karst.) Boud.
glumarum (Desm.) Boud. Humaria. (Mollisia).
consociatus (B. et Br.) Phill.
microsporus (B. et Br.) Phill.
sexdecimsporus (Cr.) Boud. Rhyparobius.
ochraceus (Cr.) Boud.
cinereus (Cr.) Boud.
granuliformis (Cr.) Boud.
argenteus (Curr.) Boud.
lacteus (Cooke et Phill.) Phill. Helotium.
aurora (Cr.) Boud.
subfuscus (Cr.) Boud.
minutissimus Boud.
Keithii (Phill.) Boud. in litt. Humaria.
globoso-pulvinata (Crossl.) Boud. in litt.
54. LASIOBOLUS Sacc.
ciliatus (Berk.) Sacc. (Ascophanus equinus).
equinus (Müll.) Karst. Ascophanus.
var. pilosus (Fr.) (Ascophanus equinus).
55. RHYPAROBIUS Boud.
crustaceus (Fuck.) Rehm. Cookei.
var. myriadeus (Karst.)
brunneus Boud.
myriosporus (Cr.) Boud.
ascophanoides (Heim.) Sacc.
albidus Boud.
tenacellus Phill.
dubius Boud.
var. *lagopi* Boud.
56. ASCOZONUS Renny.
subhirsutus Renny. Rhyparobius.
Crouani Renny. Rhyparobius.
Woolhopensis Renny. Rhyparobius.
Leveilleanus Renny. Rhyparobius.
argenteus (B. et Br.) Boud. Rhyparobius.
parvisporus Renny. Rhyparobius.
niveus (Fuck.) Boud.
57. THELEBOLUS Tode.
stercoreus Tode.
(nanus Heim.)

VI. **PYRONEMACEAE.**

58. PYRONEMA Carus.
omphalodes (Bull.) Fuck. Humaria.
=confluens (Pers.) Tul.
=marianum Car.
domesticum (Sow). Sacc. Humaria.
Piggotii (B. et Br.) Boud. Humaria.
(? = domesticum).

59. ASCODESMIS van Teigh.
nigricans van Teigh.
volutelloides Mass. et Salm.

VII. **EXOASCEAE.**

60. TAPHRINA Fr.
aurea (Pers.) Fr. Ascomyces.
rhizophora Johans.
caerulescens (Desm. et Mont.) Tul.
Sadebeckii Johans.

61. EXOASCUS Fuck.
deformans (Berk.) Fuck. Ascomyces.
Pruni Fuck. Ascomyces.
bullatus (B. et Br.) Fuck. Ascomyces.
alnitorquus (Tul.) Sadeb. Ascomyces.
turgidus Sadeb. Ascomyces.
Crataegi Sadeb.
Potentillae (Farl.) Sacc. Ascomyces.

INOPERCULEAE.

VIII. **GEOGLOSSACEAE.**

62. TRICHOGLOSSUM Boud.
hirsutum (Pers.) Boud. Geoglossum.

63. GEOGLOSSUM Pers.
glutinosum Pers.
viscosum Pers.
ophioglossoides (Linn.) Sacc. G. glabrum.
difforme Fr.

64. LEPTOGLOSSUM Cooke.
tremellosum Cooke. Mitrula microspora var. tremellossum.

65. MICROGLOSSUM Gill.
viride (Pers.) Gill. Mitrula.
arenarium Rostr.
olivaceum (Pers.) Gill. Mitrula.
atro-purpureum (Batsch) Karst.
(*rubrum* (Durand) A. L. Sm. et Ramsb.)

IX. **LEOTIACEAE.**

66. SPATHULARIA Pers.
clavata (Schaeff.) Sacc.

67. MITRULA Fr.
phalloides (Bull.) Chev.
cucullata (Batsch) Fr.
alba W. G. Sm. M. phalloides var. alba.
? minuta (Sow.)
(= Pistillaria micans).
[*microspora* (Cooke et Peck) Mass.]

68. LEOTIA Hill.
lubrica (Scop.) Pers.
atro-virens Pers. L. chlorocephala.
nana (With.) Fr.

69. CUDONIA Fr.
circinans (Pers.) Fr.
confusa Bres.

70. CUDONIELLA Sacc.
acicularis (Bull.) Schroet. Leotia.
(*Allenii* A. L. Sm.)

71. VIBRISSEA Fr.
truncorum (Alb. et Schw.) Fr.
Fergussoni B. et Br. Vibrissea Guernisaci var. leptospora.
microscopica B. et Br.

72. APOSTEMIDIUM Karst.
(= Gorgoniceps Karst.)

Guernisaci (Cr.) Boud. Vibrissea.
vibrisseoides (Peck) Boud. V. Guernisaci var. vibrisseoides.
leptospora (B. et Br.) Boud. V. Guernisaci var. leptospora.
micrometra (B. et Br.) Boud. Mollisia ("Doubtful species.")

73. PILACRE Fr.
(=Roesleria Thüm).
pallida (Pers.) Boud.

x. OMBROPHILACEAE.

74. OMBROPHILA Fr.
clavus (A. et Schw.) Cooke.
faginea (Pers.) Boud. Helotium.
alniella (Nyl.) Karst. Helotium.
imberbis (Bull.) Boud. Helotium.
helotioides Rehm.
nigripes (Pers.) Boud.
rudis (Berk.) Phill.

75. PACHYDISCA Boud.
agaricina (Berk.) Boud. Belonidium.
? ochracea (Grev.) Boud. Helotium.
brunnea (Phill.) Boud. Ombrophila.
sclerotioides (Berk.) Boud. ("Excluded.")
quisquilaris (Phill.) Boud. Helotium.
scoparia (Cooke) Boud.
immutabilis (Fuck.) Boud. Helotium.
Marchantiae (Berk.) Boud. Helotium
(var. *conocephali* Boyd.)
badia (Phill.) Boud. Helotium.
fibuliformis (Bolt.) Boud. Helotium ("Doubtful species.")
Laburni (B. et Br.) Boud. Helotium.
helotioides (Phill.) Boud.

76. CALYCELLA Fr.
citrina (Hedw.) Quél. Helotium.
lenticularis (Bull.) Boud. Helotium.
flava (Klotzsch) Boud. Helotium.
claroflava (Grev.) Boud. Helotium.
sublenticularis (Fr.) Boud. Helotium.
subsessilis (Schum.) Bull. Helotium ("Doubtful species.")
pallescens (Pers.) Quél. H. citrinum var. pallescens.
uliginosa (Fr.) Boud. Helotium.
Fergussoni (Sacc.) Boud. H. mellcum.
ferruginea (Schum.) Boud. Helotium.
Ilicis (Phill.) Boud. Helotium.
Humuli (Lasch) Boud. Helotium.

77. DISCINELLA Boud.
purpurascens (Pers.) Boud. Humaria.
(? =Boudieri Quél.)
exidiiformis (B. et Br.) Boud. Humaria.
(? =badicolor Boud.)
Menziesi (Boud.) Boud. in litt.

78. MELACHROIA Boud.
xanthomela (Pers.) Boud. Humaria.
terrestris (Niessl.) Boud. Phacidium.

XI. BULGARIACEAE.

79. CORYNE Tul.
sarcoides (Jacq.) Tul.

urnalis (Nyl.) Sacc.
aquatica Mass. et Crossl.

80. BULGARIA Fr.
inquinans (Pers.) Fr. B. polymorpha.

81. BULGARIELLA Karst.
pulla (Fr.) Karst.

XII. CALLORIACEAE.

82. CORYNELLA Boud.
atro-virens (Pers.) Boud. Coryne.
glabro-virens Boud.

83. MNIAECIA Boud.
Jungermanniae (Fr.) Boud. Humaria.

84. POLYDESMIA Boud.
pruinosa (B. et Br.) Boud. Belonidium.

85. CALLORIA Fr.
fusarioides (Berk.) Fr.
coniicola Cooke et Phill.
cornea (B. et Br.) Phill.

86. AGYRIUM Fr.
rufum (Pers.) Fr.

87. HABROSTICTIS Fuck.
lasia (B. et Br.) Boud. Orbilia.

88. ORBILIA Fr.
rubella (Pers.) Karst.
vinosa (Alb. et Schw.) Karst.
luteo-rubella (Nyl.) Karst.
coccinella (Somm.) Fr.
leucostigma Fr.
xanthostigma Fr. O. leucostigma var. xanthostigma.
(*Boydii* A. L. Sm. et Ramsb.)

Spp. of uncertain position.
retrusa Phill. et Plowr. = ? Briardia. Pseudopeziza.
flexuosa Crossl. Orbilia.
scotica Mass. Orbilia.

89. HYALINIA Boud.
incarnata (Cooke) Boud.
albella (With.) Boud. = vulgaris Fr. Pseudopeziza.
rubicola (Cooke et Phill.) Boud. Orbilia.
auricolor (Blox.) Boud. Orbilia.
succinea (Fr.) Boud. Orbilia
inflatula (Karst). Boud. Orbilia.
ulcerata (Phill. et Plowr.) Boud. (Pseudopeziza trifolii).
Leightoni (Phill.) Boud. Orbilia.
subdiaphana (Sow.) Boud.
dilutella (Fr.) Boud. Mollisia.
var. Smyrnii (Phill.) Boud. Mollisia digitalina var. Smyrnii.

XIII. CIBORIACEAE.

90. CIBORIA Fuck.
caucus (Rebent.) Fuck.
amentacea (Balb.) Fuck.
Sydowiana Rehm. Helotium renisporum.
Broomei (Phill.) Boud. Helotium.
[*ochracea* Mass.]

91. SCLEROTINIA Fuck.
tuberosa (Hedw.) Fuck.
Libertiana Fuck. S. sclerotiorum.
Fuckeliana (de Bary) Fuck.
Trifoliorum Eriksson.
bulborum (Wakk.) Rehm.
filipes (Phill.) Sacc.
Candolleana (Lév.) Fuck.
Curreyana (Berk.) Karst.
Duriaeana (Tul.) Quél.
(*muscorum* A. L. Sm. et Ramsb.)

92. STROMATINIA Boud.
rapulum (Bull.) Boud. Geopyxis.

pseudotuberosa (Rehm.) Boud. Ciboria.
subularis (Bull.) Boud. Ciboria.
baccarum (Schroet.) Boud. Sclerotinia.
fructigena (Schroet.) Boud. Sclerotinia.

93. PHIALEA Fr.
echinophila (Bull.) Quél. Ciboria.
firma (Pers.) Gill. Ciboria ochroleuca.
bolaris (Batsch) Quél. Helotium.
petiolorum (Desm.) Gill. Cyathicula.

94. CHLOROSPLENIUM Fr.
aeruginosum (Oeder.) de Not.
versiforme (Pers.) de Not.
elatinum (Alb. et Schw.) Sacc.
[*discoideum* Mass.]

95. HELOTIUM Fr.
nubilipes Boud.
chloropodium Rea et Ellis.
politum Phill.
albidum (Rob.) Pat.
[var. *Aesculi* Phill.]
herbarum (Pers.) Fr.
phyllophilum (Desm.) Karst.
pulchellum (Fuck.) Boud.
subtile Fr.
advenulum Phill.
amenti (Batsch) Fuck.
sparsum Boud.
eburneum (Desm.) Gill.
rhodoleucum Fr.
luteo-virescens (Rob.) Karst. Ciboria.
serotinum (Pers.) Fr.
lutescens (Hedw.) Fr.
aureum Pers.
repandum Phill.
phyllogenon Rehm.
rhizophilum Fuck.
fructigenum (Bull.) Fuck. H. virgultorum var. fructigenum.
Hedwigii (Phill.) Mass.
tuba (Bolt.) Fr. ("Doubtful species.")
pygmaeum (Fr.) Karst. Dasyscypha.
Aspegrenii Fr.
gramineum Phill.
bryophilum (Fr.) Mass.
flexuosum Mass.
sulphuratum (Schum.) Phill.
epiphyllum (Pers.) Fr.
sublateritium B. et Br.
rubescens Cr.
salicellum (Hazsl.) Fr.
phascoides Fr.
cyathoideum (Bull.) Karst.
sordidum (Fuck.) Rehm. H. Fuckelii.
Urticae (Pers.) Karst.
axillaris (Nees) Boud. Humaria (Mollisia).
scutula (Pers.) Karst.
var. Menthae Phill. } as forms.
var. Rudbeckiae Phill. }
virgultorum (Wahl.) Karst.
aquaticum Curr.
calyculus (Sow.) Berk.
emergens (Cooke et Phill.) Mass.
nitidulum (B. et Br.) Mass.
moniliferum (Fuck.) Rehm.
strobilinum (Fr.) Fuck.
Carmichaeli (Berk. et Phill.) Mass.
terrigenum Cooke et Phill.
tetraascosporum Rea.

96. STAMNARIA Fuck.
Equiseti (Hoffm.) Sacc.

97. CYATHICULA de Not.
coronata (Bull.) de Not.
inflexa (Bolt.) Sacc. (C. coronata).

alba (Pat.) Sacc.

98. PERISTOMIALIS Phill.
Berkeleyi Boud. = P. peristomialis B. et Br. Cyathicula peristomalis.

99. BELONIDIUM de Not.
vexatum de Not. (= Phialea incarnata Quél).
minutissimum (Batsch) Phill.
Clarkei Mass. et Crossl.
[*Jerdoni* (Cooke et Phill.) Mass.]

100. BELONIUM Sacc.
excelsius (Karst.) Boud. Belonidium.
filisporum (Cooke) Sacc. Belonidium.
Arctii (Phill.) Sacc. Belonidium.
rhabdospermum (B. et Br.) Boud. (Tapesia aurata).

XIV. LACHNELLACEAE.

101. DASYSCYPHA Fr.
virginea (Batsch) Fuck.
var. *selecti* Karst.
? globuligera Fuck.
nivea (Hedw. fil.) Sacc.
bicolor (Bull.) Fuck.
luteola (Curr.) Sacc. Helotium.
crucifera (Phill.) Sacc.
laetior Karst.
Fragariastri (Phill.) Mass.
Spiraeaecola (Karst.) Sacc.
scintillans Mass.
ciliaris (Schrad.) Sacc.
patula (Pers.) Sacc.
Soppittii Mass.
acuum (Alb. et Schw.) Sacc.
acutipila (Karst.) Sacc.
controversa (Cooke) Rehm.
perplexa Boud.
callimorpha (Karst.) Sacc. ("Position doubtful.")
Rhytismatis (Phill.) Sacc.
? Comitissae (Cooke) Sacc.
stigmella (Cooke) Sacc. ("Position doubtful.")
pulverulenta (Lib.) Sacc.
cerina (Pers.) Fuck.
calyculaeformis (Schum) Rehm.
var. latebricola Rehm.
clandestina (Bull.) Fuck.
? conformis (Cooke) Sacc.
brunneola (Desm.) Sacc.
var. fagicola (Phill.) (D. fuscescens).
diplocarpa Curr. Diplocarpa Curreyana.
fuscescens (Pers.) Rehm.
trichodea (Phill and Plowr.) Sacc. D. trichiodea.
patens (Fr.) Sacc. D. palearum.
diminuta (Rob.) Sacc.
(*campylotrichi* A. L. Sm.)

102. HYPHOSCYPHA Bres.
nuda (Phill.) Boud. Helotium.

103. ERINELLA Sacc.
juncicola (Fuck.) Sacc. (E. apala).
pommeranica Ruhl.
apala (B. et Br.) Sacc.

104. LACHNELLA Fr.
suphurea (Pers.) Quél. Dasyscypha.
leucophaea (Pers.) Boud. Dasyscypha.
barbata (Kunze) Fr. Dasyscypha.
corticalis (Pers.) Fr. Dasyscypha.
canescens (Phill.) Cooke Dasyscypha.
tricolor (Sow.) Phill. Dasyscypha.
spadicea (Pers.) Phill. Dasyscypha.
siparia (B. and Br.) Phill. Dasyscypha.

nidulus (Schm. et Kunze) Quél. Dasyscypha.
araneo-cincta Phill. Dasyscypha.
albo-testacea (Desm.) Quél. Dasyscypha.
prasina Quél. Dasyscypha.
horridula (Desm.) Quél. Dasyscypha.
inquilina Karst.
plano-umbilicata (Grev.) Phill.
* *Nylanderi* (Rehm.) Boud. in litt. Erinella.
* *setulosa* (Mass. et Crossl.) Boud. in litt. Echinella.
* *Crosslandi* (Mass.) Boud. in litt. Echinella.
(*orbicularis* Phill.)
(*brunneo-ciliata* Phill.)
(*Laburni* Phill.)

105. TRICHOSCYPHA Boud.
calycina (Schum.) Boud. Dasyscypha.
var. Trevelyani (Cooke).
Wilkommii (Hartig.) Boud. (D. calycina).
subtillissima (Cooke) Boud. Dasyscypha.
Abietis (Karst.) Boud. Dasyscypha.
resinaria (Phill.) Boud. Dasyscypha.

106. PITHYELLA Boud.
ilicincola (B. et Br.) Boud. Mollisiella.
hydnicola (B. et Br.) Boud. Mollisiella.
? Hypnorum (Fr.) Boud. = ? Mollisiella.
? erythrostigma (B. et Br.) Boud. ("Excluded species")

107. ARACHNOPEZIZA Fuck.
aranea (de Not.) Boud. Dasyscypha.
aurelia (Pers.) Fuck. Tapesia.
aurata Fuck. Tapesia.

108. HYALOSCYPHA Boud. = Allophylaria Karst.
leucella (Karst.) Boud.
hyalina (Pers.) Boud. Dasyscypha.
vitreola (Karst) Boud.
punctiformis (Grev.) Boud. Helotium.
punctoidea (Karst.) Boud. Dasyscypha.
? straminea (B. et Br.) Boud. Mollisia.
dentata (Pers.) Boud. Mollisia.
candidata (Cooke) Boud. Dasyscypha.
farinacea (Cooke et Mass.) Boud.

109. MICROPODIA Boud.
chrysostigma (Fr.) Boud. Mollisia.
Bullii (W. G. Sm.) Boud. Dasyscypha.
pteridina (Karst.) Boud.
dumorum (Desm.) Boud. Dasyscypha.
Oedema (Desm.) Boud. Dasyscypha.
†hyalina (Phill.) Boud. Dasyscypha luzulina.
grisella (Rehm.) Boud. Dasyscypha.
filicea (Cooke et Phill.) Boud. Dasyscypha.
concolor (Phill.) Boud. Helotium.

* Lachnella ou peut-être un Belonidium. (Boud. in litt.)

† The specific name given by M. Boudier is taken from Saccardo Syll. Vol. VIII. p. 449, where it is given as "*Dasyscypha hyalina* (Phill.) Sacc. *Peziza hyalina* Phill. Grev. iv. p. 121, pl. 51, f. 266." The specific name bestowed by Phillips was *luzulina* (see Grev. iv. p. 121 [pl. 51 fig. 266]).

aspidiicola (B. et Br.) Boud. Dasyscypha.

110. URCEOLELLA Boud.

scrupulosa (Karst.) Boud. Dasyscypha.

deparcula (Karst.) Boud. Belonidium.

? flaveola (Grev.) Boud. (Mollisia chrysostigma).

effugiens (Desm.) Boud. Mollisia.

versicolor (Desm.) Boud. Mollisia.

puberula (Lasch) Boud. Dasyscypha.

Mali (Rehm.) Boud. Mollisia.

elaphines (B. et Br.) Boud. Dasyscypha.

micacea (Pers.) Boud. Dasyscypha.

incarnatina (Quél) Boud.

paulula (Rob. et Desm.) Boud. Pseudopeziza.

viburnicola (B. et Br.) Boud. Mollisia.

papillaris (Bull.) Boud. Dasyscypha.

spirotricha (Oud.) Boud. Dasyscypha asterostoma.

Berkeleyi (Blox.) Boud. Dasyscypha.

Tami (Lamy) Boud. Dasyscypha.

var. Humuli (Phill.) (D. Tami.)

leuconica (Cooke) Boud. Dasyscypha.

Stevensoni (B. et Br.) Boud.

Richonis Boud.

Pteridis (Alb. et Schw.) Boud. Dasyscypha.

aspera (Fr.) Boud.

fugiens (Phill.) Boud. Dasyscypha.

stereicola (Cooke) Boud. Dasyscypha.

melaxantha (Fr.) Boud. Dasyscypha.

arundinis (Fr.) Boud.

111. TRICHOPEZIZA Fuck.

eriobasis (Berk.) Boud. Tapesia.

trabilennoides (Rehm.) Boud.

escharoides (B. et Br.) Boud (Dasyscypha dematiicola)

Grevillei (Berk.) Sacc. Dasyscypha.

carinata Cooke et Mass. Dasyscypha.

flavo-fulginea (Alb. et Schwein.) Sacc.

citricolor (B. et Br.) Sacc. Dasyscypha.

dematiicola (B. et Br.) Sacc. Dasyscypha.

asema (Phill.) Sacc. D. ascuna.

episphaeria (Mart.) Lamb. ("Excluded species.")

XV. MOLLISIACEAE.

112. PYRENOPEZIZA Fuck.

Mercurialis (Fuck.) Boud. Mollisia.

nervicola (Desm.) Boud.

riccia (Sacc.) Boud. (Pseudopeziza discolor).

arenivaga (Desm.) Boud. Pseudopeziza.

maculans (Rehm) Boud.

arundinacea (DC.) Boud. Mollisia.

graminis (Desm.) Sacc. Pseudopeziza.

cyanites (Phill.) Boud. Belonidium.

digitalina (Phill.) Sacc. Mollisia.

Carduorum Rehm. Mollisia.

Rubi (Fr.) Rehm. Pseudopeziza.

Tamarisci (Roum.) Sacc.

Plantaginis Fuck. Mollisia.
betulicola Fuck.
grisella (Cooke et Phill.) Boud. Dasyscypha Carmichaeli.
urticicola (Phill.) Boud. Mollisia.

113. EPHELINA Sacc.
Rhinanthi (Phill.) Sacc. E. radicalis.
[*Prunellae* Phill.]

114. PIROTTAEA Sacc.
veneta Sacc. et Speg. Echinella senecionis.
vectis (B. et Br.) Phill. Echinella.

115. CORONELLARIA Karst.
amaena Boud.

116. MOLLISIA Fr.
juncina (Pers.) Rehm.
Pineti (Batsch) Phill.
atro-cinerea (Cooke) Phill.
Browniana (Blox.) Sacc. Pseudopeziza.
fallax (Desm.) Gill.
ramealis Karst.
benesuada (Tul.) Phill. Pseudopeziza.
aquosa (B. et Br.) Phill.
discolor (Mont. et Fr.) Phill. Pseudopeziza.
cinerea (Batsch) Karst.
melaleuca (Fr.) Sacc.
cinerella Sacc.
caesia (Fuck.) Sacc Tapesia.
cinerascens Rehm.
livido-fusca (Fr.) Gill.
chionea Mass. et Crossl.
conigena (Pers.) Boud. Helotium.
Typhae (Cooke) Phill. Pseudopeziza.
palustris (Rob. et Desm.) Karst. Pseudopeziza.
Curreyana Phill. (Pseudopeziza palustris).
ventosa Karst. Belonidium.
atrata (Pers.) Karst.
var. Asparagi Wint.
var. Oenanthes Phill.
jugosa Phill. et Plowr.
Ebuli (Fr.) Karst. Pseudopeziza.
lignicola Phill.
fusca (Schum.) Karst.
dactyligluma Cooke.

117. TAPESIA Fuck.
fusca (Pers.) Fuck.
Rosae (Pers.) Fuck. T. fusca var. rosae.
prunicola Fuck. T. fusca var. prunicola.
mutabilis (B. et Br.) Phill. Mollisia.
sanguinea (Pers.) Fuck.
retincola (Rabenh.) Karst.
Bloxami (B. et Br.) Sacc Karschia.
Johnstoni (B.) Phill. (T. fusca).

118. NIPTERA Fr.
pilosa (Crossl.) Boud.
lacustris Fr. Belonidium.
punctum (Rehm) Sacc.
pulla (Phill. et Keith) Boud. Belonidium.
Stockii (Cooke et Phill.) Boud. Echinella.

119. MOLLISIELLA Boud.
filicum (Phill.) Boud. Mollisia.
epithallina (Phill. et Plowr.) Boud. Mollisia.
albula (Phill.) Boud. Mollisia.
? Hypnorum (Fr.) Boud. = ? Pithyella.
Teucrii (Fuck.) Boud. Mollisia.
[umbonata (Pers.) Boud.]
var. amenticola Fuck.

120 SPILOPODIA Boud.
nervisequa (Pers.) Boud. Mollisia.

(*Hymenoscypha Symphoricarpi* Phill.)

XVI. **PATELLARIACEAE.**

121. PATINELLA Sacc
Euphorbiae (B. et Br.) Sacc.
Pseudopeziza.
macrospora Mass.
rubrotingens (B. et Br.) Sacc.

122. PLACOGRAPHA Th. Fr.
flexella (Ach.) Th. Fr. Patinella.

123. HETEROSPHAERIA Grev.
patella (Tode) Grev.

124. PSEUDOPHACIDIUM Karst.
Callunae Karst.

125. NESOLECHIA Massal.
oxyspora (Tul.) Massal.
cladoniaria (Nyl.) Zopf.
leptostigma (Nyl.) Sacc. et D. Sacc.

126. LAGERHEIMA Sacc.
sphaerospora (Berk. et Cooke.) Sacc.

127. ABROTHALLUS de Not.
Parmeliarum (Somm.) Nyl.

128. KARSCHIA Körb.
lignyota (Fr.) Sacc.
Bloxami (Berk. et Phill.) Sacc.
advenula (Leight.) Zopf.
epiphorbia (Leight.) Zopf.

129. MELASPILEA Nyl.
vermifera Leight. Scutularia.

130. CATINELLA Boud.
olivacea (Batsch) Boud. Patinella.

131. PATELLARIA Wahl.
Abbotiana (Sow.) Sacc.
[*macrospora* (Fuck.) Phill.]

132. LECIOGRAPHIA Mass.
inspersa (Tul.) Rehm.
parellaria (Nyl.) Sacc. et D. Sacc.
plumbina Anzi.

133. MYCOBACIDIA Rehm.
arenicola (Nyl.) Sacc. et D. Sacc.

134. DURELLA Tul.
compressa (Pers.) Tul.
Patellaria.
connivens (Fr.) Rehm.
Patellaria.
lecideola (Fr.) Rehm. Patellaria.
melanochlora (Somm.) Rehm.
parvula (Cooke) Sacc.
atro-vinosa (Blox.) Sacc.
Patellaria.
livida (B. et Br.) Sacc
Scleroderris.

135. LECANIDION Rabenh.
atratum (Hedw.) Rabenh.
Patellaria.
clavisporum (B. et Br.) Sacc. Patellaria.
proximum (B. et Br.) Sacc.
Patellaria.
Lonicerae (Phill.) Sacc.
Patellaria.
subtectum (Cooke et Phill.) Sacc. Patellaria.
maurum (Phill.) Sacc. Patellaria.
atro-album (Cooke) Sacc.
Patellaria.
Crataegi (Phill.) Sacc. Patellaria.
minutissimum (Phill.) Sacc.
Patellaria.
Hyperici (Phill.) Sacc.
Patellaria.

136. BLITRYDIUM de Not.
calyciiforme (Rebent.) de Not.

137. TRIBLYDARIA Sacc.
melaxantha (Fr.) Sacc.
Blitrydium

138. SCUTULARIA Karst.
littoralis (Phill. et Plowr.) Sacc.

? citrina (Chev.) Sacc. ? = Apostemidium.
[*vermifera* (Phill.) Sacc.]

139. SCUTULA Tul.
cristata (Leight.) Sacc. et D. Sacc.

140. BIATORELLA de Not. = Tromera Massal.
resinae (Fr.) Mudd.
difformis (Fr.) Wain.
pinicola (Massal.) Th. Fr.
fossarum (Duf.) Rehm.
moriformis (Ach.) Th. Fr.

XVII. DERMATEACEAE.

141. VELUTARIA Fuck.
rufo-olivacea (Alb. et Schw.) Fuck. Schweinitzia
fraxinicola (B. et Br.) Boud. (S. rufo-olivacea)

142. PEZICULA Tul.
amaena Tul. Cenangium.
cinnamomea (Pers.) Sacc. Scleroderris.
dryina (Cooke) Sacc. Cenangium.
rhabarbarina (Berk.) Tul. Scleroderris rubi.
eucrita Karst.
nectrioides (Phill.) Sacc. Cenangium.
Fagi (Phill.) Boud. Scleroderris.

143. DERMATEA Fr.
Cerasi (Pers.) de Not. Cenangium.
Frangulae (Fr.) Tul. Scleroderris.
Pseudoplatani Phill. Scleroderris.
umbrina Cooke et Mass. Cenangium.
Houghtoni Phill. Scleroderris.

144. CENANGIUM Fr.
Prunastri (Pers.) Fr. Phaeangella.
pulveraceum (Alb. et Schw.) Fr.
Sarothamni Fuck.
leoninum Cooke et Mass.
subnitidum Cooke et Phill. Phaeangella.
Abietis (Pers.) Duby.
acicolum (Fuck.) Rehm.

145. ENCOELIA Fr.
furfuracea (Roth.) Karst. Cenangium.
populnea (Pers.) Schroet. Cenangium.
tiliacea (Fr.) Karst.
Bloxami Phill. Cenangium.

146. PHAEANGIUM Sacc.
phaeosporum (Cooke) Boud. Schweinitzia.

147. TYMPANIS Tode.
conspersa Fr.
Ligustri Tul.
Fraxini Fr.
alnea (Pers.) Fr.

148. LAQUEARIA Fr.
sphaeralis Fr.

149. CENANGELLA Sacc.
Pinastri (Tul.) Sacc. Tympanis.

150. PHAEANGELLA Sacc.
Ulicis (Cooke.) Sacc.
Empetri (Phill.) Boud.

151. SCLERODERRIS Fr.
ribesia (Pers.) Karst.
seriata (Fr.) Rehm.
fuliginosa (Pers.) Karst.
bacillifera (Karst.) Sacc.
amphibola (Massal.) Gill.
majuscula Cooke et Mass.

152. GODRONIA Moug.
Ericae (Fr.) Rehm. Crumenula.
callunigena Karst. Crumenula ("Doubtful Species.")
urceoliformis Karst. Crumenula.

Ledi (Alb. et Schw.) Karst. Crumenula ("Doubtful species.")

153. Pocillum de Not.
Cesatii (Mont.) de Not.
Boltonii Phill.
Needhami Mass. et Crossl.

154. Trochila Fr.
craterium (DC.) Fr.
Laurocerasi (Desm.) Fr.
var. smaragdina Lév.
Buxi Capron.
Salicis Tul.

xviii. **STICTIDACEAE.**

155. Propolis Fr.
faginea (Schrad.) Karst.
Rosae Fuck. (P. faginea).
rhodoleuca (Somm.) Fr.

156. Ocellaria Tul.
aurea Tul.
chrysophaea (Pers.) Quél.
Masseana Sacc. et Syd. O. succinea Mass.
punctiformis (Pers.) Sacc.

157. Naevia Fr.
seriata (Lib.) Fuck. Phacidium.

158. Xylographa Fr.
parallela (Ach.) Fr.
spilomatica (Anzi) Th. Fr.
laricicola Nyl.
scaphoidea Stirt.

159. Cryptodiscus Corda.
pallidus (Pers.) Corda.
angulosus Karst.
microstomus (Carm.) Sacc.

160. Phragmonaevia Rehm.
hysterioides (Desm.) Rehm.

161. Odontotrema Nyl.
longius Nyl.

162. Stictis Pers.
radiata (Linn.) Pers.
annulata Cooke et Phill.
sulfurea Rehm.
atro-alba (Phill. et Plowr.) Sacc.
stellata Wallr.
arundinacea Pers.
[Luzulae Lib.] var Junci Karst. S. arundinacea var. Junci.

163. Lasiostictis Sacc.
conigena Sacc. et Berl.

164. Schizoxylon Pers.
Berkeleyanum (Dur. et Lév.) Fuck.
sepincolum Pers.

165. Nemacyclus Fuck.
niveus (Pers.) Sacc.

166. Melittosporium Corda.
pteridinum (Phill. et Buckn.) Sacc.
lichenicolum (Mont.) Mass.

xix. **PHACIDIACEAE.**

167. Cryptomyces Grev.
maximus (Fr.) Rehm. C. aureus

168. Phacidium Fr.
Vaccinii Fr.
multivalve (DC.) Kunze et Schm.
minutissimum Auersw.
infestans Karst.
abietinum Kunze et Schm.
striatum Phill. et Plowr. Coccomyces.
humigenum Cooke et Mass. P. terrestre var. humigenum.
simulatum Berk. et Cooke. Pseudopeziza.
Calthae Phill. Pseudopeziza

169. Keithia Sacc.
tetraspora (Phill.) Sacc.

170. Pseudopeziza Fuck.
Trifolii (Biv.-Bern) Fuck.
Medicaginis (Lib.) Sacc.
radians (Rob. et Desm.) Karst
Cerastiorum (Wallr.) Fuck.
Ranunculi (Wallr.) Fuck.
repanda (Fr.) Karst.
Alismatis (Phill. et Trail) Sacc.

Artemisiae (Lasch) Mass.
foecunda (Phill.) Mass.
[sphaeroides (Pers.) Fuck.]
var. Lychnidis (Phill.) (P. sphaeroides.)
petiolaris (Alb. et Schw.) Mass.

171. STEGIA Fr.
Ilicis Fr. Trochila.

172. SCHIZOTHYRIUM Desm.
Ptarmicae Desm.
aquilinum (Schum.) Rehm.

173. SPHAEROPEZIA.
Empetri Fuck.

174. CELIDIUM Tul.
varians (Dav.) Arn.

175. COCCOMYCES de Not.
coronatus (Schum.) de Not.
dentatus (Kunze et Schm.) Sacc.
quadratus (Kunze et Schm.) Karst.
Pini (Alb. et Schw.) Karst. Coccophacidium.
Clematidis (Phill.) Sacc. Phacidium.
Rubi (Fr.) Karst.
(*Boydii* A. L. Sm.)

176. PSEUDOGRAPHIS Nyl.
elatina (Ach.) Nyl.
pinicola (Rebent.) Rehm.

177. COLPOMA Wallr.
quercinum (Pers.) Wallr.

178. SPOROMEGA Corda.
degenerans (Fr.) Corda. Colpoma.

179. RHYTISMA Fr.
acerinum (Pers.) Fr.
punctatum (Pers.) Fr.
salicinum (Pers.) Fr.
Andromedae (Pers.) Fr.
Urticae Fr. ("Doubtful Species.")
Empetri White.
[*Patellea pallida* (Berk.) Mass.]
[*Masseea quisquilarum* (Berk. et Cooke.) Sacc.]

SOME NOTES ON THE HISTORY OF THE CLASSIFICATION OF THE DISCOMYCETES.

By J. Ramsbottom, M.A., F.L.S.

When one considers the material size of certain Discomycetes as e.g. *Morchella*, it seems safe to assume that they must have been observed from very early times. The oldest writer who is known to have written about fungi is Theophrastus (c. 300 B.C.). Theophrastus was a disciple of Plato and Aristotle, and his Historia Plantarum and De Causis Plantarum are the oldest botanical treatises in existence. He was deservedly called by Linnaeus the "Father of Botany," his works abounding in astute observations. His classification of flowering plants into trees, shrubs, undershrubs and herbs is met with up to very recent times. He knew the lower forms of vegetable organisms, fungi—both terrestrial and subterranean—lichens and algae. Unlike many in after times he was convinced that they were plants, though without stem, leaf, root or seed. He says little about fungi, although he evidently distinguished four different kinds, as he speaks of ὕδνον, μύκης, πέζις and γεράνειον (κεραύνιον). All are described as having no root, and are therefore imperfect plants. There is nothing sufficiently descriptive to enable us to know definitely what fungi the names denote. "He seems to have taken it for granted that the people of his time knew what particular plants he was speaking of, and that therefore there was no need of particular definite description. We have to learn what fungi the Greek names really denote by comparing what Theophrastus has said with what other Greek and Roman writers have recorded." Pliny (79 A.D.) has much concerning fungi, though probably most of it is compiled from other writers. He considers it beyond a doubt that the fact that any plant should spring up and grow without a root is amongst the very greatest of the marvels of Nature. "Belonging to the mushroom genus, also, there is a species known to the Greeks by the name of 'pezica' which grows without either root or stalk." The name *Helvella* or *Helvela* was used by Cicero apparently to denote some kind of fungus.* From one of Cicero's letters it would seem that the fashion of eating fungi originated in the desire to substitute some dainty kind of food

* Considered by many later writers to be l'Oronge-vraie, *Amanita caesarea.*

for certain expensive animal food forbidden by the Lex sumptuaria, the law which regulated the expenses of the table. Products of the soil were not included in the act. "While those elegant eaters wish to bring into high repute the products of the soil which are not included in the act, they prepare their fungi, helvellae, and all vegetables with such highly seasoned condiments, that it is impossible to conceive anything more delicious." In De Re Coquinaria Libri Decim (often attributed to Apicius) are mentioned certain fungi under the name *sfonduli*, *funguli* or *spongioli*. Most writers consider that this refers to the morel, the modern Italian name *spongiole* giving the clue to its identity.

At the time of the Renaissance the whole aim of botanists seems to have been to obtain clearness as to the identity of the plants mentioned by classical authors. The descriptions of the latter were copied or translated, though much original matter was often added. Dioscorides (c. 64 A.D.), a physician living in the time of Nero, was for more than sixteen centuries looked upon as almost the sole authority in the study of botany and in the identifications of medicines. His work was translated into Latin by Ruelle in 1516, and for the next century the statements of Dioscorides formed the basis of practically every botanical work. Barbaro, a Venetian, who at the age of fourteen received from the hand of the Emperor Frederick the poetic crown, and who boasted of having found five thousand mistakes in the writings of Pliny, was apparently the first to give names to fungus genera after the Renaissance. In 1516, in his commentary on Dioscorides, he speaks of several distinct kinds of fungi, amongst which are pezicae and spongioli. He regards the latter, as is usual, as morels. Ruelle (1536), the rival of Barbaro in the interpretation of the classical authors, considers them, however, to be what are now known as Boleti, and gives the name meruli (or metuli) to the morels.

Cesalpino (1519-1603), senior physician to Pope Clement VIII., is well-known to systematists by his classification of plants based principally on the seed and fruit. In his De Plantis, the fungi are placed in the fifteenth class in which flowers and fruit are wanting. They form the fourth section of this class, together with certain marine animals. Many fungi are given, including *Pezica*. By the time of Cesalpino it was usually considered that the πέζις of Theophrastus, concerning which there had been much controversy, was what is now known as *Lycoperdon*.* The name is compared with the modern Italian name *vescia* both in sound and meaning.

* From the fact that Theophrastus is quoted as describing the fungus as having a smooth skin, it has been held that he had in mind *Lycoperdon giganteum*.

Clusius (de l'Ecluse), born at Arras in 1526, is the first writer who attempted to treat fungi otherwise than as mere accessories. He had rather a wandering kind of existence. He gave an account of plants observed in Spain and Portugal, and afterwards those of Austria and Hungary. He is supposed to have added over six hundred new species to science. For fourteen years he resided at the court of Vienna, then moved to Frankfort and there had an annual subsidy from William IV., Elector-Palatin of Hesse. This was stopped by William's son, and in 1593 Clusius was called to Leyden and appointed Professor of Botany. An accident to his foot put an end to his scientific excursions. We are told that "when seated in his botanical chair at Leyden, his authority was respected on all hands, and all discoveries were laid at his feet." He is said to have introduced the potato into Austria and Germany, and "our gardens are indebted to him for the cherry-laurel and horse-chestnut, now so common and so ornamental, which he received, among other plants from the imperial ambassador at the Porte . . . . and it is but just that his memory should be perpetuated along with those two beautiful trees, with which all botanists of taste ought for ever to associate his name, thus giving him a monument more lasting than brass or marble." In his Rariorum Plantarum Historia (1601), he has a separate treatise on fungi—Fungorum Historia—giving an account of the fungi of Pannoi, a province on the south of the Danube. This work consists of twenty-six pages, and is illustrated by thirty-two wood cuts, all original except three, which are copied from Dodoens (1583).†

The fungi were divided in a manner common since the time of Dioscorides, who had written "Fungi have a twofold difference, for they are either good for food or poisonous," and adds, "Their poisonous nature depends on various causes, for either such fungi grow amongst rusty nails or rotten rags, or near serpents' holes, or on trees producing noxious fruits." Pliny also considers that if by chance fungi should grow near a hob-nail, or a piece of rusty iron, or a bit of rotten cloth, they will immediately imbibe all these foreign emanations and flavours and transform them into poison. The first of Clusius' drawings depicts the morel of which four species are described. There is also in existence at the Leyden library a collection made by Clusius of eighty-three water-colour draw-

† The three Netherland botanists, Dodoens, de l'Ecluse and de l'Obel, were intimate friends and "freely imparted their observations to one another, and permitted the use of them, and also of their figures, in one another's books." They had the same publisher, Plantin, "and as he bore the expense of their blocks, he had an agreement with the three authors that their illustrations should be treated as common property."

ings of fungi. These have recently been published by Istvánffi to celebrate the tricentenary of Clusius. Istvánffi comments on the drawings and gives, where possible, the modern names. The painting was supervised by Boldizsár de Batthyány, a man of great valour, but one who had such a love of natural history that he is reputed to have liberated a Turkish prisoner on condition that he sent him plants from Turkey. István de Beythe, who accompanied Clusius on many of his Viennese excursions, might also be considered as a collaborator to this code. He added the Magyar names of the fungi and also notes regarding their habitats, whereas Batthyány added the German names.

Clusius' published figures were much copied. Dodoens (1616) has the figures of the morel under the name Fungi praecoces. He has also a figure of a large Discomycete which he calls Fungus semiorbicularis (sessiles), and which he considers fits in with the description given by Pliny of Pezica, and is therefore classed with a *Lycoperdon*. Colonna (Columna) in 1606 gives two figures of Fungi Pezicae which are cup fungi. In his text, however, he adds other fungi which are apparently Agaricaceae.

Clusius' Historia served as the basis of Caspar (Gaspard) Bauhin's Pinax (1623). Both John and Caspar Bauhin, "that noble pair of brothers," as Tournefort calls them, were the sons of John Bauhin, who, we are told, was, at the age of seventeen, taken into the service of Catharine, Queen of Navarre, and made her physician. John was the elder brother by twenty years. He accompanied Gesner on his European travels, and collected a prodigious number of plants, which formed the basis of his Historia published (1620), badly edited, after his death. The drawings of fungi included in the section, Excrementa terrae, ut fungi et tubera, are mostly reduced copies of those of Clusius. The same four species of morel are given. He calls them Fungus rugosus or cavernosus, or Merulius. Caspar benefited much from his brother's experience, being made Professor of Greek at twenty-two, and afterwards professor of anatomy and botany, of which, his epitaph informs us, he was the Phœnix. Both brothers attempted to straighten out the tangle that botanical names had been jumbled into during the previous century. The Pinax of the younger brother, which took forty years to prepare, was really a synonomy of botanical names, and gave botanists a working foundation until the time of Linnaeus.

Another who was dependent upon the work of Clusius, one who himself confessed that if it had not been for him he could not have undertaken the work, was Van Sterbeeck, a Flemish priest, who worked at fungi for more than twenty

years before publishing his Theatrum Fungorum in 1675. Clusius' Code came into the hands of Dr. Syen, professor of medicine at the Leyden University, and were lent by him to Sterbeeck. Sterbeeck's aim was strictly utilitarian. He desired to make known poisonous plants and therefore included in his work certain phanerogams. More than two-thirds of the copper engravings seem to have been copied from Clusius' paintings. The smaller fungi are neglected, but one plate is devoted to morels of which ten figures are given, including nine species; also a drawing is given of *Sarcoscypha coccinea* (oreille cramoisie de Judas-Iscariote) and of *Peziza aurantia*, both copied from Clusius.* The descriptions, which are in Flemish, are good, and contain many original observations. The work has been quoted by many mycologists, including Fries. Sterbeeck's drawings are in the Royal Library at Brussels.

John Ray, the famous Cambridge botanist, in his Methodus Plantarum Nova, 1682, places fungi in the Plantae Imperfectae. They are classified into Arborei, Terrestres, and Subterranei. The terrestrial fungi are divided into Cauliferi and Caules carentes. One of the three sections of the latter is Tenuiores, membranum seu corium referentes; Pezicae *Plinii*—and apparently refers to cup-fungi. In his Synopsis (1690), which concerned the fungi of this country, and the Historia (1686-1704), which included the fungi of the world, he has also classifications of "Mushromes or Toad-stools." The Historia mentions two species of Pezicae in the fungi without gills and calls them "Cup-mushrome."† Ray was fortunate in having a large number of correspondents, most of them capable botanists. They gave their observations freely to Ray, who uses them with due acknowledgment.

Tournefort, famous for his clear conception of genera, has, in his Eléments de Botanique, 1694, a group devoted to plants which have neither flowers nor seeds. He has a genus *Boletus*, which is comprised of four species, *Morchella*, *Clathrus* and *Phallus*. There are figures of the two former. In his Institutiones Rei Herbariae 1700 he adds the genus *Fungoides*, which includes the cup fungi.

The name most closely associated with Ray is that of the German Dillenius, the "Lynx of Nature." The period of his activity was a memorable one in the history of botany, immediately succeeding what Linnaeus represented as "the

* A further plate is copied from Robert Hooke and is the one printed in connection with Miss Smith's Presidential Address, see Trans. Brit. Mycol. Soc., Vol. III., 1908, Fig. 2.

† In the second edition concerning the first species Fungus Pezicae Plinii, we are informed that "Mr. Doody shewed me the same springing up in his own garden in the Strand, London."

Golden Age of Botany." In 1719 Dillenius published his Catalogus plantarum sponte circa Gissam nascentium, in which there are 160 species of fungi. The plants are arranged according to the months in which they appear, and the fungi are given in the October and November section, though December, January and February are also mentioned as their season. Dillenius' classification of fungi shows much advance on any of the previous attempts. It is apparently based on the later classifications of Ray, though certain of the divisions had been hinted at, or stated, in some of the older Herbals. The first division is into Fungi pileati et pediculo donati and Fungi pileis destituti. In the Lamellis carentes section of the former and the Scrobiculis excavatus group the genus *Morchella* appears, with one species. The genus is diagnosed in the Appendix and is stated to be the *Boletus* of Tournefort, the *Fungus porosus* of Caspar Bauhin, and the *Merulius* of J. Bauhin. In the Non Cauliferi of the second division we find a group Concavi. This Dillenius regards as the Pezicae of Pliny. He alters the name to *Peziza*, which genus is described as "pediculo etiam utplurimum, pileo vero semper caret, & ex substantia homogenea membranacea, concava & aquam continere apta, tenera plerumque, aliquando tamen, ut in seminiferis, subdura constat." The genus is divided into a. Membranacei & tenuiores with eleven species and b. Duriores, Calyciformes, seminiferi putati with two species. The latter are Nidulariaceae, and the former includes *Hirneola* and *Craterellus*. A drawing is given of *Peziza*, but it is impossible to distinguish the species. William Sherard was at once struck with the merit of the Catalogus and the attention given to the Cryptogams led him to enter into a correspondence with Dillenius, the outcome of which was that in 1721 he persuaded Dillenius to accompany him to England, where he was engaged in arranging Sherard's great collection of plants. Sherard's great aim in life seems to have been to continue Caspar Bauhin's Pinax, and on his death he left £3,000 to found and support a botanical professorship at Oxford, bequeathing his library, herbarium and the manuscript of his Pinax, the completion of which he intended should be one of the objects and duties of the new professor. Dillenius was made the first professor. In 1724 appeared the third edition of Ray's Synopsis. This was edited by Dillenius, though his name is not mentioned on the title-page. Twenty-two species of *Peziza* are given, whereas only two, Fungus Pezica Plinii and Fungus Pezica altera, were given in the second edition. Three figures are given, Peziza lenticularis parva miniata, P. lutea parva marginibus pilosis, and P. lutea parva marginibus laevibus. The genus naturally includes certain unrelated fungi such as *Hirneola*, *Craterellus*, and *Cyathus*. Dillenius was considered by his contemporaries as having a very good knowledge

of fungi. In one of his letters Sherard writes, "Dillenius was recommended to me as a person very curious in mushrooms and mosses, as I perceive he is." We know that Dillenius was a good artist, as witness his drawings in the Historia Muscorum, which Sir J. E. Smith tells us he has "known it stand, fairly lettered and untouched on the shelves of collectors as a *history of the muscovites*." He, however, published no series of drawings. Sherard writes, "Dr. Dillenius is much improved in his painting. He has copied for me all Mr. Dandridge's fungi, and as many as he has been able to procure about London." These drawings are still preserved at Oxford with full descriptive notes. They have been recently examined by Mr. Massee, who gives the modern names and thus enables us to understand more clearly the fungi Dillenius mentions.*

Vaillant, 1727, uses the name *Fungoides* in the sense of Tournefort, and gives several figures. *Leotia* is figured, but placed in the genus *Fungus*. The treatment of the cryptogams in this work (Botanica parisiense) is surprising, seeing that in 1717 Vaillant gave them up as hopeless and did not seem to favour the classical idea that they were certainly the food of the gods, if not their children. In a naturally much quoted passage he says, "I entirely disregard these insidious flowers without flower, a cursed race which appears to have been created or invented only to overawe the most skilful and to drive young botanists absolutely mad, who, being released from them, can enter with head elevated the vast Empire of Flora and become masters of all parts of the flower."

When one considers the study of fungi from a historical point of view it is surprising to find how the interest centres in the work of a certain few botanists, no matter which group of fungi is in question. One of these is the Florentine botanist Micheli. His Nova Plantarum Genera, published in 1729, is a book remarkable in every way. He was accused by his contemporaries of making too much use of the microscope, and even e.g. by Dillenius, of inventing certain things. Micheli followed Tournefort's method and was helped by some drawings of Breyne and by a manuscript of Baldi. However, the excellence of his own observations leave him quite free to acknowledge any possible assistance that he may have received. He is convinced, as was Baldi, that fungi contain flowers and seeds, and that there is no plant in nature that is deprived of them. According to this idea he thought that the best method to follow in the classification of fungi was one that depended upon the disposition of these parts. He

* Fungus faviginosus = Morchella esculenta and Fungoides quercinum peltatum nigrum = Bulgaria polymorpha.

carefully investigated fungi in order to make out the position of the spores. He sowed the spores of many genera and obtained, in his successful experiments, the same fungus. He was probably the first to do this. He noticed the arrangement of spores in fours in certain Agarics* and also the cystidia in *Coprinus*, and was the first to notice the ascus. This he seems to hint at it in several cases, and some of his drawings, especially in Lichens, are more or less conclusive, but he clearly figures and describes it in *Tuber*, where he mentions that two, three or four spores can occur in the sac. The fungi as such are divided into four principal groups, according as to whether "flowers" or "seeds" are present. The former section is then divided according as to whether the fungus is fleshy or not, regular or irregular. The second section is divided into those fungi with superficial seeds and those in which the seeds are enclosed. This method of dividing fungi according to the position of the spores exists to the present day. The Discomycetes studied by Micheli find their place in different groups. *Leotia* and *Helvella* together with various Agaricaceae such as *Craterellus* and *Nyctalis* are placed in the genus *Fungöidaster*. *Mitrophora* and *Morchella* are distinguished as *Phallo-Boletus* and *Boletus* respectively, and *Phallus* is regarded as a genus distinct from both. The Pezizas are placed in Tournefort's genus *Fungoides*. Sixty-two species are described and classified in four groups: Fungoidea fungiforma; Fungoidea cava, aut plana, pediculo donata; Fungoidea scutellata, sive olmoidea; and Fungoidea turbinata, aut pyri inversi, vel vasis fusorii forma. This division of the genus *Fungoides* is suggestive of many of the later classifications of the Discomycetes.

Linnaeus seems to hold fungi somewhat in disrespect. for we find that in one of his pupil's theses that he upheld at Upsala it was debated whether fungi ought not to form a new natural kingdom, neither animal nor plant that might be called the neuter kingdom or chaos.† In his sexual system he does not, as one would have expected, follow the system of Micheli, but follows rather that of Dillenius, of whom he had a very high opinion. He dedicated to him his Critica Botannica, and also wrote that no one in England cared for or understood genera except Dillenius; he called the genus *Dillenia* after him, which did not please Dillenius, although it was described as being "of all plants the most distinguished for the beauty of its flower and fruit, like Dillenius amongst botanists." In

* In alquibus singillatim dispersa G, in aliis quaterna sibi contigua H. (Tab. 73).

† Cf. also: Fungorum ordo in opprobrium artis etiamnum Chaos est, nescientibus Botanicis in his, quid Species, quid Varietas sit. (Phil. bot.).

the Systema Natura 1735, he has a list of fungus genera in which occur, *Merulius* B. *Morchella* D.; *Elvela. Fungoides* D.; *Peziza* D. *Cyathoides* M. In the Species Plantarum 1753, he chooses his generic names in what seems a very despotic manner. Previous authors had taken great trouble to try and make out to what fungi the names mentioned by the writers of antiquity should be applied, but Linnaeus apparently ignores this. Comparing the names given by Tournefort with those of Linnaeus, we find that the *Fungus* of Tournefort becomes *Agaricus* with Linnaeus; *Agaricus*, *Boletus; Fungoides*, *Elvela* and *Peziza*. The authority of Linnaeus was such, that his generic names were accepted in a group of which he knew little. Thus after this, generic names have a certain stability. The fact that Linnaeus also applied the binomial system of nomenclature so rigorously gives him the right to rank as one of the greatest benefactors to the study of mycology. The rather prevalent idea that Linnaeus was the first to apply binomial names to plants is far from correct. Barbaro (1516), Dodoens, and the brothers Bauhin, had a large number of such names; but Linnaeus, by using a single specific name throughout botany and zoology in place of the usual specific descriptions, made his greatest contribution to Science. The Discomycetes in the Species Plantarum are grouped under the three genera *Phallus*, *Elvela* and *Peziza*. *Phallus* includes the stink horn, and *Phallus esculentus*. The name *Elvela* (of which two species are given) was changed in the second edition to the more usual *Helvella*. *Peziza* contained eight species and included *Poronia*, *Craterellus* and *Cyathus*. The herbarium of Linnaeus, as everyone knows, is at present housed in the rooms of the Linnaean Society. The wife of Linnaeus seems to have been a very weird sort of lady. On Linnaeus' death she sold, at her own price, the botanical remains of her husband to their only surviving son. On the death of the latter, "his museum and library reverted to his mother and sister, as he had never been married; and the former immediately fixed her eyes on sir Joseph Banks, as the most likely person to purchase these relics at the high price, as she thought it, of a thousand guineas. On his refusal, and by his kind recommendation and advice, they came into the hands where they now are. The sale was precipitated by the return of the King of Sweden, then on his travels, lest he should oblige the heirs to dispose of the whole at a cheaper rate to the University of Upsal. This would actually have been the case, as appears from the exertions made by his Majesty on his return, who sent a courier to the Sound, and a vessel by sea, to intercept the ship which was bearing away the prize." So writes Sir J. E. Smith, who was the lucky purchaser. There is a photograph of Smith in

Thornton's botany surmounting a drawing showing the episode of the ships. It looks as if a lot of the story remains to be told, as the ships appear to be only a few yards apart. The affair, however, is merely a pleasant myth. In a letter written by Smith after the arrival of the collection he apparently knows nothing of the matter, and Dr. D. B. Jackson pointed out to me that the King of Sweden knew nothing of the sale until a fortnight after the collection had left the country. Out of ten specimens of *Peziza*, *Elvela* and *Phallus* in the herbarium only three are true Discomycetes.

The notorious Sir John Hill, in his Natural History of Plants, 1751, describes certain species of Discomycetes under the name *Encoelia.* Five species are described fully, and with a certain amount of imagination. The rest are divided into stipitate and sessile species. As is usually the case in this work these "will easily be distinguished by their names."* They are thirty-two in number, such as "The little brown Encoelia" and "The little scarlet Encoelia." As in the work of Micheli, *Cyathus* is separated off from *Peziza (Cyathoides* Mich. *Cyathea* Hill*)*; "the fructifications are so extreamly different, that nothing can be more evident, than their belonging to two distinct genera." The morels are placed with *Phallus* in the genus *Dictyaria.* We owe the genus *Leotia* to Hill. It is described as "consisting of a pedicel and a head: the head is plain on it's upper surface, and neither porous, lamellated, nor echinated in it's under one, but perfectly smooth." Three species are described, nine are easily "distinguished by their names." Hill follows Micheli very closely in one thing. All his illustrations are copied from the latter either faithfully (the drawing being merely reversed) or with a slight, skilful, though obvious alteration. Naturally there is not a word mentioned of this, though the author frequently finds fault with Micheli where he differs from him in his descriptions.

Another writer who copies Micheli's illustrations is Gleditsch in his Methodus Fungorum 1753, though he states that he has not serviley copied Micheli's statements regarding the fructifications but has certified himself as to their correctness. He gives a classification, arranged in tabular form, of the genera of fungi, based upon the position of the "fruit." These may be dispersed on the surface, situated on special receptacles, enclosed in a cavity, or enclosed in the substance of the fungus. *Elvela* is placed in the first group (plicato-concavi et variae figurae) and has eleven species and numerous varieties. The genus includes disc-shaped species, *Helvella*, *Hirneola*, &c. The morels are placed in the second group, included in the genus

* Apparently in this work eighty-seven species of fungi are described and two hundred and fifty species have a sufficiently descriptive name.

Phallus. The genus *Peziza* forms the third group, but the Nidulariaceae are intended. "We are inform'd by Gleditch that Morels are observ'd to grow in the woods of Germany in the greatest plenty, in those places where charcoal has been made. Hence the good women who collect them to sell, receiving a hint how to encourage their growth, have been accustom'd to make fires in certain places of the woods with heath, broom, *Vaccinium,* and other materials, in order to obtain a more plentiful crop. This strange method of cultivating Morels, being however sometimes attended with dreadful consequences, large woods having been set on fire and destroy'd by it, the magistrate thought fit to interpose his authority and the practice is now interdicted."†

Battara, in his Fungorum Historia, 1755, divides fungi into eighteen classes. He does not use the Linnaean names for genera, but uses generic names in their pre-Linnaean connotation. The species described are figured. The genus *Boletus* includes *Phallus, Clathrus, Morchellaceae, Helvellaceae* and *Acetabula.* The genus *Peziza* is placed in the Fungi membranacei, with six species which include Discomycetes, Nidulariaceae, *Hirneola,* etc.

Schaeffer published many coloured figures of Discomycetes in his Fungorum Icones 1762. He follows Linnaeus with regard to genera. His *Elvella* is composed principally of Discomycetes, but also includes *Craterellus* and *Nyctalis. Morchella* is included under *Phallus. Peziza* is composed of Nidulariaceae. In the body of the work the species are merely numbered, but in the index a very full and useful synonomy is given. In the Index 1770 there is a "Versuch einer ordentlichen Eintheilung" giving an arrangement of fungi which is based upon the position of the "fruit." The Elvelae are divided into Petiolatae (Mitrae, Phalliformes, Floriformes, Hypocrateres, and Buccina Scop.), Subacaules and Acaules, sessiles (Scyphi, Patellae). The work was rendered much more valuable by Persoon, who published a commentary on it in 1800.

The famous Haller, in his Historia stirpium Helvetiae, 1768, places fungi in the nineteenth and last class, as they do not possess stamens. He has thirty-one species of *Peziza,* which he divides into Pezizae cavae (1. P. membranaceae, 2. P. gelatinosae, 3. P. ceraceae) and Pezizae planae. Twenty years previously Haller had written to Linnaeus from Gottingen, where he was professor of anatomy, "The place where I am is but a barren field for botany excepting fungi, which are plentiful. I have detected a very curious elastic motion in the common sessile Peziza of a dirty white hue. The whole plant

† Cf. Gleditsch l.c. p. 60.

contracts spontaneously and discharges a powder upwards with a sort of hissing sound. This doubtless is the seed." In the same letter he had previously given vent to a remark that somehow seems to ring true: "fungi are a mutable and treacherous tribe." The Rev. John Lightfoot, in his Flora Scotica mentions under *Peziza cochleata* a similar discharge of spores. "It has been observ'd to be endu'd with an internal elastic motion, impowering it to project, when rubbed or irritated by the finger, to the height of some inches, a subtle powder like smoke. It is probable that others of this genus are possessed, at certain seasons, of the same quality." This fungus was met with on our Haslemere foray and many of us watched the discharge of spores, which takes place about a couple of seconds after the irritation.

Scopoli, in the second edition of his Flora carniolica 1772, arranges the fungi in similar sequence to that of Gleditsch and Schaeffer. *Morchella* is included in *Phallus*. *Elvela* is divided into the sections Buccina, Auriculae, Scyphi, Patellae and Disci. *Leotia* and *Craterellus* appear in the first section and species of Discomycetes in the last three sections. In the first edition Linnaeus had been rather closely followed.

Batsch, in his Elenchus Fungorum, 1783-1799, classifies fungi into two principal groups, Externa and Interna depending upon the position of the "seeds." In the second section of the former, in which the spores are on the upper surface, we find *Peziza*, with the receptacle concave at first, and *Phallus* with the receptacle convex. The thirty species of *Peziza* in the first volume are divided into Ceraceae, Pilosae, Furfurosae and Lentifera. Coloured illustrations of the species are given and the characters are, according to Batsch, either drawn from nature or taken from Micheli or Schaeffer. *Phallus* is divided into three sections, Acaules, Lobati and Reticulati. The first section contains the single fungus *Rhizina inflata;* the second *Helvellaceae;* and the third *Phallus* and *Morchella*. Batsch differs from Linnaeus in his use of the name *Elvela*. This he applies to various Basidiomycetes such as *Stereum*.

Other botanists noted various species of Discomycetes, but it remained for Hedwig in 1789 to make a great contribution to the knowledge of the structure of these plants. John Hedwig was a Hungarian who became professor of botany and physic at Leipsig. Possessed of a very good microscope made by a friend, he became famous for his studies on the minute structure of mosses. He, however, also studied lichens and fungi. In his Stirpium cryptogamicarum he gives twenty-eight splendid drawings of Discomycetes, depicting, exceptionally clearly, the eight spores in the ascus, and the paraphyses. He

founds a new genus *Octospora* for the reception of the species with eight ascospores. He calls the asci, thecae, and gives the name paraphyses to the well known sterile filaments of the hymenium. The term spore was also invented by him, but he only appears to have used it for mosses. It is this botanist who gives his name to the well-known cryptogamic periodical Hedwigia. The younger Hedwig, his son, was also a cryptogamist, but his work was never published owing to difficulties which his friend De Candolle had with publishers. He died at a very early age and his results were used by De Candolle in his flora; the genus *Gymnosporangium* is, for example, one of R. A. Hedwig's genera.

Bulliard (1791) classifies fungi in a manner which is by this time becoming fairly common. Four groups are given depending upon whether the spores are (1) enclosed, (2) exposed on all parts of the surface, (3) exposed on the upper portion of the pileus, or (4) only on the lower portion. *Phallus (Morchella)* and *Peziza* form the third class, and *Helvella* occurs in the fourth. Thirty-nine species of *Peziza* are given, and these are divided into four sections: those found only on the leathery fruits of certain trees or on those of annual plants; those growing only on dead wood; those found only on the dung of animals; and those growing only on the earth. Eleven species of *Helvella* are described, but such genera as *Craterellus* and *Cantharellus* are included. All the species are figured.

We now come to certain ground in the work of Persoon. This unfortunate genius contrived to do his work under remarkable circumstances. He is to this day often called the "Prince of Mycologists," an appellation he earned during his lifetime by his superlative work on fungi. On one occasion, when addressed as Prince, thinking he was being made sport of, he replied, "Yes, Prince, and here are my subjects. There are some dried between sheets of paper and here are some preserved in alcohol. There are some who will be poisoned with corrosive sublimate, and others who await a burning fire. Instead of saying 'Prince' you had better say 'Tyrant,' and a tyrant more terrible than Denis, because at Syracuse it at least was warm, and I freeze at Paris." Persoon's classification of fungi is completely set forth in his Synopsis methodica fungorum 1801. The basis of Persoon's classification is the position of the hymenium, a term used by Persoon to designate the fruiting surface, a point which is yet the basis of fungus classification. The first division into Angiocarpi and Gymnocarpi depends upon whether the fruit is closed or open, a distinction which we have seen is made more or less clearly by certain of the earlier mycologists. The Angiocarpi are divided into

Sclerocarpi with hard pericarp, Sarcocarpi with fleshy pericarp, and Dermatocarpi where the pericarp is membranous. In the first group are *Hysterium* and *Xyloma (Rhytisma)*, and in the second *Thelebolus*. The Gymocarpi are divided into Lytothecii, Hymenothecii, and Naematothecii. The Hymenothecii, which consist of Basidiomycetes and Discomycetes, are divided into Agaricoidei, Boletoidei, Hydnoidei, Gymnodermata, Clavaeformes and Helvelloidei. *Geoglossum* is placed with *Clavaria* in the Clavaeformes, though afterwards Persoon placed it in the Helvelloidei.* The genera included in the Helvelloidei are: *Spathularia*, *Leotia*, *Helvella*, *Morchella*, *Tremella*, *Peziza* β *Stictis* γ *Solenia*, *Ascobolus*, *Helotium*, *Stilbum* and *Aegerita*. Fourteen species of *Xyloma* are described, seven species of *Geoglossum* and one variety, one species of *Spathularia*, nine species of *Leotia*, ten species of *Helvella* and one variety, eight species of *Morchella*, one hundred and fifty-two species of *Peziza*, four species of *Ascobolus*, and seven species of *Helotium*. It is obvious that the whole group has taken on a totally different aspect. The asci are described as having eight spores in *Ascobolus* and *Peziza*. The species of the latter genus are arranged in seven lettered sections. Excluding the section G, which is *Solenia*, the remaining groups correspond to the families of later classifications. The division depends upon the consistency of the cup and its external characters. The section A (Tremelloideae) included those species with a more or less tremelloid consistency, and is practically Saccardo's Bulgarieae: section B (Helvelloideae) composed of large fleshy species is, more or less, Fries' subgenus *Aleuria;* section C, with strigose, pilose, tomentose, or pubescent exterior, the subgenus *Lachnea* and section D, fleshy-waxy smooth species the subgenus *Phialea*. The section E is composed of more or less coriaceous plants which are dry and smooth or pulverulent. This and the next section F (Stictis) form the basis of the Phacidiaceae, Stictidiaceae, etc., of recent authors.

Albertini and Schweinitz, in their Conspectus Fungorum, 1805, followed Persoon's classification. They added several new species of Discomycetes. The seven sections of *Peziza* receive the names Tremelloideae, Helvelloideae, Pezizoideae (a. Hirtae [C], b. Glabrae [D]), Coriaceae, Stictides and Soleniae.

De Candolle in Flore française (1805) follows the main lines of Persoon's classification. The genus *Peziza* is divided according to the consistency into coriaceous, fleshy, waxy and gelatinous species.

Link (1809), in his Anandrae (sexus masculinus non de-

* Traité sur les champignons, p. 42 (1818).

claratus) has the fungi grouped into Epiphytae, Mucedines, Gasteromyci and Fungi. The Gasteromyci include *Xyloma*. Nine genera of Discomycetes are included in the second series of the fourth section. Asci containing spores are drawn in many Basidiomycetes.

Nees von Esenbeck in Das System der Pilze (1816-1817) arranges *Xyloma* in the Protomyci. In the second group (Fungi clavati et pileati), *Spatularia*, *Geoglossum*, and *Leotia* are placed in the Clavariae stipitatae and *Helotium*, *Helvella* and *Morchella* in the Clavariae Mitrati. The third group (Fungi utrini) includes Gastromycetes and *Peziza* and *Ascobolus* (Fungi calycini). This genus is divided thus: Sessiles; Stictis, Patellariae, Denudatae, Villosae and Pruinosae: Pedicellatae; Calycinae, Dasyscyphi, Macroscyphi and Hymenoscyphi.

Fries, in his Systema mycologicum II., 1823, places the majority of the Discomycetes in his fourth family Hymenomycetes, which also includes Basidiomycetes. The Evoluti section of the Hymenomycetes ("ascis perfectis") is divided into Pileati, Clavati, Mitrati and Cupulati. The Clavati contains *Geoglossum*, *Spathularia* and *Mitrula*, together with Clavariaceae. The Mitrati and Cupulati form the Hymenomycetes uterini or Elvellaceae. The former consists of the genera *Morchella*, *Helvella*, *Verpa*, *Leotia*, *Vibrissea* and *Rhizina;* the latter is divided into Pezizeae (*Peziza* a. *Discina*, b. *Helotium*, *Patellaria*, *Ascobolus* and *Bulgaria*), Dermeae (*Ditiola*, *Tympanis*, *Cenangium*, and *Stictis* a. *Corticia*, b. *Xylographa*, c. *Propolis)* and Heteroclitae *(Solenia* and *Cyphella)*. Thus the Cupulati of Fries is the *Peziza* of Persoon. *Rhytisma*, *Phacidium* and *Stegia* are placed in the Pyrenomycetes, a section of the Gasteromycetes.

A system of classification of fungi very similar to that of Link is Brongniart's (1824). His "Champignons proprement dits" is divided into Helvellacées, Clavariées and Agaricées. The Pézizées of the former include *Solenia* and *Cyphella* together with the rest of Persoon's *Peziza;* the Helvellées contains only genera of the modern family. The Clavariées include *Mitrula*, *Spathularia*, and *Geoglossum* together with *Clavaria*, etc. Brongniart is of the opinion that there are no true "grain nues," and thinks that all spores that have been described thus, have been confused with the membrane of the conceptacle or have already escaped from this organ. We have seen how Link had described spores inside the vesicles for which Guillemin afterwards proposed the term basidia. After his time it was considered by practically every mycological writer that the spores of all Hymenomycetes were contained in thecae. Persoon (1818) writes "Les *theca*,

ou utricules . . . renferment des sporules que l'on présume être les semences *(gongylus, sporula, sporangium)*, mais qui y sont en petit nombre, et souvent imperceptibles." Micheli had noted the arrangement of spores in fours in certain Agarics, and this was well-known, being, in fact, mentioned by Persoon who saw the same thing in three species of *Thelephora* and figured it in his *T. caesia.** This quaternary arrangement is easily observed in the black spored genus *Coprinus*. Link held that there was a single row of spores in the thecae of most Basidiomycetes, but that in *Coprinus* there were four such rows and figured them, the figure being afterwards copied by Nees von Esenbeck, who, it may be mentioned, proposed the name ascus, objecting to the name theca as it had been previously used for mosses. Figures of internal spores are quite common at this period. In 1837 Corda, in Sturm's Deutschlands Flora, gave a figure of *Coprinus micaceus* showing four rows of spores, one in each corner of an ascus. The spores of four contiguous asci give the quaternate arrangement. A drawing of *Coprinus petasiformis* given in his Icones fungorum (1836) shows basidia with external spores, and also suggests how the misinterpretation had arisen, being doubtless a later drawing. Even so late as 1876, Sautermeister indicated that asci were present in Basidiomycetes, and Massee in 1888 states that this had not been corroborated and "even if it should be done it is nothing extraordinary." Drawings showing external spores attached to basidia seem to be extremely rare before 1830. The earliest drawing of a basidium I know of, which clearly shows external spores and no internal ones, is that of Vittadini, Monographia Tuberacearum, Tab. 5, 1831. In 1836 Ascherson published a short note in which he states that he has found that the spores of Agaricinae are borne in the definite number four on the exterior of a cylindrical organ; in *Boletus* the number appeared to be three. The next year, Léveillé, a Parisian physician, after working for twelve years on the subject, published his researches on the structure of the hymenium. He showed past all possible doubt that the spores in Agarics, Boleti, etc., are

* In Greville's Scottish Cryptogamic Flora, Vol. V., pl. 264 (1827) there is depicted *Thelephora laciniata*. Asci are shown containing four brown spores. Concerning this Berkeley remarks "In 1825 Fries separated *Thelephora* from *Auricularia* on account of the quaternary arrangement of the sporidia. Dr. Greville followed him in this separation, but apparently did not understand Fries correctly, as the asci of *Thel. laciniata* are figured as containing a single row of four sporidia, whereas Bulliard figured to a certain degree correctly their quaternary arrangement on a peduncle, a fact which Fries could not have overlooked. Indeed experience has clearly shown that Dr. Greville must have been misled by a confidence in Fries' correctness, who, however, appears not to have had himself a very clear perception on the point."

external and are usually four in number. He had previously convinced Persoon, who had stated that he could not understand how organs so constant had not been noticed by microscopists. Léveillé used Persoon's name Hymenotheci or Thecospori for fungi with asci, and Fries' name Hymenomycetes or Basidiospori for fungi with basidia. De Bary afterwards applied the names Ascomycetes and Basidiomycetes to the two groups. The position of such genera as *Craterellus* and *Spathularia* was finally settled. So startling was Léveillé's paper that a committee was appointed consisting of Brongniart and Guillemin to report on it. After calling in Decaisne they, after a thorough investigation, confirmed all the facts brought forward by Léveillé. The latter also pointed out the function of spores and distinguished them from seeds in that they do not contain an embryo. The following year (1838) Berkeley published his researches on the spore bearing organs of the Basidiomycetes. He was unaware of Léveillé's paper, and wrote in answer to a paper by Montagne, who had also written on the subject but had missed the whole point. Berkeley's paper is just as convincing as that of Léveillé, and he gives clear figures. He also gives an excellent historical account of the subject and points out, by referring to his contribution to Smith's English Flora, that in 1836 he had seen the basidia in certain Agarics, e.g., *A. prunulus*. Berkeley also separates off *Geoglossum*, *Mitrula*, and *Spathularia* from the Clavariaceae. That others were on the track is seen by the fact that Phœbus in 1838 gives as the essential character of the Basidiomycetes the possession of vesicles bearing four stalked spores. His many figures show this clearly.

Corda, in 1842 (Anleitung) divides fungi into Coniomycetes, Hyphomycetes, Myelomycetes, and Hymenomycetes. The Hymenomycetes fall into two great groups, according as whether the hymenium is composed of asci, Ascophori or basidia, Basidiophori. The Ascophori are separated into Pyronemeae *(Pyronema, Midotis)*; Agyriaceae *(Agyrium)*; Patellariaceae *(Cryptodiscus, Mellitiosporium, Patellaria)*; Pezizeae *(Propolis, Stictis, Volutella, Peziza, Bulgaria, Ascobolus, Sarea, Cyphella, Cenangium, Tympanis, Cordierites)*; Geoglossaceae *(Geoglossum)*; Leotiaceae *(Vibrissea, Mitrula, Spathulea, Leotia)*; Helvellaceae *(Verpa, Helvella, Morchella)*. The genera comprising the Phacidei of Fries are placed in the Hysteriaceae, a family of the Myelomycetes.

Rabenhorst, in his Deutschlands Kryptogamen Flora, 1844, has a somewhat different classification. The primary divisions are Coniomycetes, Hyphomycetes, and Dermatomycetes. The last named is then divided into Sphaeriacei (the second section of which is the Phacidiacei, including Hysteriacei), Lycoper-

dacei, and Hymenini. The Hymenini are subdivided into Tremellini, Clavariaceae, Helvellacei and Pileati. *Pyronema* and *Agyrium* are included under Hymenuli, *Helotium* and *Midotis* (together with *Guepinia* and *Cyphella*) under Helotiei of the Tremellini; the Clavariaceae are divided into Clavariei, Mitrulini (*Geoglossum*, *Mitrula*, *Spathulea*) and Sparassidei; the Helvellacei into Cupulate (*Stictis*, *Cenangium*, *Tympanis*, *Solenia*); Claviculares (*Volutella*, *Vibrissea*); Pezizei (*Bulgaria*, *Ascobolus*, *Lecanidion*, *Peziza*, *Rhizina*) and Mitrati (*Leotia*, *Verpa*, *Helvella*, *Morchella*).

A third classification of the period, which was not without influence, is that of Léveillé 1846. Six classes of fungi are given, one of which, the Thécasporés, is equivalent to our modern Ascomycetes. These are divided into Ectothèques, with asci situated at the surface of the receptacle, and Endothèques, with internal asci. The former are divided into Mitrés (Géoglossés, Morchellés, Helvellés) and Cyathydés (Cyttariés, Pézizés, Agyriés, Cenangiés, Stictés). Hysteriaceae, Phacidiaceae, etc., are included in the Ectothèques together with the remaining Ascomycetes.

It is obvious that the classifications put forward by various authors at this period have been greatly influenced by Fries. An amplified classification was put forth by this writer in his Summa vegetabilium Scandinaviae 1849. This system is often used at the present day with practically no modifications. It is in this work that the Discomycetes are first established with their present significance. The work is so important that it is only for want of space that it is not given here in full. Sixty-four genera or subgenera are given with about five hundred species. The following scheme gives the principal divisions.

DISCOMYCETES.

a. Fugaces, disco excipulo saturatius colorato.
   1. *Helvellacei*, excipulo ceraceo, ascis fixis persistentibus.
   2. *Bulgariacei*, excipulo subgelatinoso, ascis erumpentibus.
   3. *Dermatei*, excipulo suberoso, ascis varie desciscentibus.

b. Persistentes, induratae, excipulo disco saturatiori.
   4. *Patellariacei*, excipulo coriaceo, ambitu orbiculari integro.
   5. *Phacidiacei*, excipulo corneo rimose aut valuatim hiascente.
   6. *Stictei*, excipulo oblitterato vel nullo.

The order Helvellacei included cup shaped, mitrate and clavate forms.

Monographs on the group, or on portions of it, now begin to appear. De Notaris, in his Profilio dei Dis-

comyceti (1864) treats the group in a general way, but gives no systematic arrangement. Certain new genera are diagnosed, resource being made to microscopic characters such as the form and colour of the asci, paraphyses and spores. The cell structure of the excipulum was also occasionally used, especially in generic descriptions.

Nylander (1868) followed the classification of Fries. He described accurately and fully the characters of the asci and spores, and gave careful measurements. He appears to have been the first to use iodine solution for colouring asci as a means of distinguishing between genera. In 1869 Boudier's beautifully illustrated and epoch-making monograph of the Ascobolaceae appeared, the brothers Crouan having previously rather specialised in these attractive fungi. Various workers, amongst whom the most famous are the Tulasne brothers, de Bary, Woronin, van Tiegham and Brefeld, began to work at the morphology of the group and obtained results which were to some extent used by systematists. Fries himself never became an expert microscopist, but other workers improved the Friesian classification by using microscopic methods.

Fuckel, Symbolae Mycologicae, 1869, follows the system of Fries to a large extent. His divisions are Stictei, Phacidiacei, Patellariacei, Bulgariacei (a. Vegetabilicoli et terricoli, b. Fimicoli), Pezizei and Helvellacei. The number of species was now becoming so great that large numbers of new genera began to be formed. Fuckel had thirty-two genera in his Pezizei, differing in microscopic characters as well as in habit, consistency, colour and external features.

Karsten, in his first writings on these fungi, more or less adopted the generic limits of Fries. In his Mycologica Fennica, 1871, however, he drew the generic limits closer, but not to the extent that Fuckel had done. His scheme of classification is as follows: Helvellaceae (Cudonieae, Mitruleae, Helvelleae), Pezizaceae (Rhizineae, Pezizeae, Bulgarieae, Helotieae, Mollisieae, Cenangieae, Stictideae) and Phacidiaceae. The structure and consistency of the excipulum was used as a help in separating the subfamilies of the Pezizaceae.

In 1884 Saccardo published his Conspectus, giving as families of the Discomycetes: Helvelleae, Pezizeae, Ascoboleae, Dermateae, Bulgarieae, Sticteae, Phacidieae, and Patellarieae; Calicieae and Gymnoasceae were given in an appendix. The genera were arranged in Saccardo's well-known spore groups. The eighth volume of Saccardo's Sylloge Fungorum (1889) contains the Discomycetes. There is a slightly different division—Cyttarieae, Helvelleae (Morchelleae, Geoglosseae), Pezizeae, Ascoboleae, Dermateae, Bulgarieae, Sticteae, Phacidieae, Pattellarieae, Cordieriteae, and Gymnoascaceae (Euas-

ceae, Gymnoasceae); Calicieae is in the appendix. In this work Saccardo raises many of the subgenera of his Conspectus to generic rank, and also adds many new genera.

One of the classifications at present most used by workers in this country is that of Rehm in Rabenhorst's Kryptogamen Flora (1887-1894). It is unique in that so many genera which are usually considered to be lichens are incorporated. The two main divisions are Pezizaceae and Helvellaceae. The former are divided into Phacidiaceae (Euphacidieae, Pseudophacidieae); Stictideae (Eusticteae, Ostropeae), Tryblidieae (Tryblidiaceae, Heterosphaerieae); Dermataceae (Cenangieae, Dermateae, Patellariaceae [Pseudopatellarieae, Eupatellarieae]: Appendix Calicieae and Arthonieae), Bulgariaceae (Callorieae, Bulgarieae), and Pezizeae. The Pezizeae are divided into Mollisieae (Eumollisieae, Pyrenopezizeae [Pseudopezizeae, Eupyrenopezizeae]); Helotieae (Euhelotieae [Pezizelleae, Cyathoideae, Hymenoscypheae, Sclerotieae], Trichopezizeae (Dasyscypheae, Lachneae]); Eupezizeae and Ascoboleae (Pseudoascoboleae, Euascoboleae). The second main division, Helvellaceae is divided into Rhizineae, Geoglosseae (Eugeoglosseae, Leotieae) and Helvelleae.

Schröter, in Cohn's Krypogamen-Flora 1893, has a rather similar classification to that of Rehm. The principal divisions are Taphriineae, Ascocorticiineae, Helvellinei, Pezizinei, Cenangiinei, Stictidinei, Phacidiinei, and Hysteriinei. The first two, and the last families are excluded from the Discomycetes by Rehm.

Schröter also commenced the classification of the Ascomycetes in Engler and Prantl's Pflanzenfamilien. Here there are ten principal divisions based upon the position occupied by the asci. The Protodiscineae include the Exoascaceae and Ascocorticiaceae. The Helvellineae, Pezizineae, Phacidiineae and Hysteriineae are regarded as "Discomycetes." The Helvellineae are divided into Geoglossaceae, Helvellaceae and Rhizinaceae; the Pezizineae into Pyronemaceae, Pezizaceae, Ascobolaceae, Helotiaceae, Mollisiaceae, Celidiaceae, Patellariaceae, Cenangiaceae, Cordieritidaceae and Cyttariaceae. This is the classification taught in most of our "schools." It is to be regretted that Schröter did not live to work it out. The work had only reached to the Pezizaceae when Schröter died. The classification was carried on by Lindau, who followed the same lines. The Phacidiineae contains the Stictidaceae, Tryblidiaceae and Phacidiaceae.

We now reach the classification of Discomycetes proposed by Boudier. In 1869 this famous mycologist pointed out that he distinguished clearly two different methods by which the ascus opened. In the one case the ascus dehisced by means of

a lid (operculum) at its summit; in the other by means of a pore (foramen), with more or less elevated margin, formed at the extreme apex. Other observers had noticed these methods of dehiscence, e.g., Tulasne; and the brothers Crouan had made the presence of the operculum a character of the genus *Ascobolus*, and had joined up to it other genera in which they observed the same phenomenon. In a paper read before the Woolhope Field Club at their fungus foray in 1879, Boudier suggested that this difference of dehiscence differentiated the Discomycetes into two distinct and coherent groups. Only in very rare cases was there any difficulty in placing a fungus into one of these groups. He pointed out that other characters differentiated the two groups. In the operculate species the spores are simple, spherical, or more frequently oval or elliptical, with ends rounded, rarely acuminate, often warted, sometimes reticulate; the receptacles are always waxy in consistency; the hairs are generally of a definite structure; the species grow on earth, dung, soil or old trees, rarely on sound dead wood or on bark: in the inoperculate species, the spores have a tendency to septation, none are verrucose or areolate, rarely spherical but mostly fusiform, more or less elongated and sometimes clavate, often more or less curved, and in general much smaller than in the operculate species; the consistency is firmer and more elastic than in the first section; the hairs have a different appearance; the species are rarely terrestrial, but more often grow on dead leaves and stems and sometimes even on living branches. In the first volume of the Bulletin of the Mycological Society of France, Boudier elaborated a system and gave a key to the fleshy species of Discomycetes. He pointed out that the asci in the operculate species are generally larger, more cylindrical and more rounded at the tip than are those of the inoperculate species. On the whole it would seem that the divisions have the same importance as have the Monocotyledons and Dicotyledons in Phanerogams. The "Histoire et Classification des Discomycètes d'Europe," gives a full classification of the group with generic descriptions and a list of species which enter into these. The key to the British genera given in this number of our Transactions is based upon this work, and the various divisions and their distinctions may be seen there. Another work of Boudier which is invaluable is the Icones Mycologicae (1904-11), which contains the most exact and the most beautiful drawings of Discomycetes that have ever been published. There are excellent descriptions of nearly four hundred species of this group which are figured. It is a matter of surprise that the system of Boudier has not been generally adopted. Perhaps it is because it has never been set out in full with complete specific descriptions.

The work of Durand (1900), who investigated the structural relations of the families of the Discomycetes and later published a monograph on the Geoglossaceae, and that of Lagarde (1906) point conclusively to the value of certain of the groups proposed by Boudier.

It has been thought best to treat the English Floras together. Hudson (Flora Anglica 1762) and Lightfoot (Flora Scotica 1777) follow Linnaeus' classification. This is also followed by Withering in the first edition of his Botanical Arrangement, 1776, "Funnel top" being given as the popular name for *Peziza* and "Turban top" for *Helvella*. In the second edition, Bulliard's system is adopted.

Hooker, in Flora Scotica 1821, followed "for the most part" the Synopsis of Persoon. Gray's Natural Arrangement of Plants, 1821, groups fungi into Protomyceae, Nematomyceae, Gasteromyceae, Sarcotheceae, Hymenotheceae, and Lytotheceae. The Hymenotheceae are the Fungi clavati and pileati of Esenbeck. *Xyloma* is included in the Protomyceae with the rusts and smuts. *Coryne* is placed near *Tremella* in the Sarcotheceae. In the Hymenotheceae the group N, Geoglossideae contains *Geoglossum*, *Mitrula*, *Leotia*, *Helotium* and *Relhanum;* group O, Helvellideae, *Morchella*, *Helvella* and *Spathularia;* group P, Pezizadeae, *Stictis*, *Patellaria*, *Peziza*, *Octospora*, *Scodellina*, *Calycina*, *Dasyscyphus*, *Macroscyphus* and *Hymenoscyphus;* and group Q, Ascobolideae, *Ascobolus*. As in the case of the other plant groups, the generic limits are drawn rather narrowly, and but for the International Rules many of the genera would have to be adopted. Greville, Flora Edinensis, 1824, places the Discomycetes in his group "Fungi." Division 8 contains *Clavaria*, *Phacorhiza* and *Geoglossum;* Division 9 (Helvelloideae) *Leotia*, *Helvella*, *Morchella* and *Phallus;* and Division 10 (Pezizideae) *Peziza* and *Ascobolus*.

Berkeley, in Smith's English Flora, 1836, follows Fries' system. He added many species of Discomycetes. Cooke adopted Berkeley's views almost *in toto* till 1892, when in his Introduction to the study of fungi he arranged the genera according to Saccardo's system, though he did not use the groupings based upon the colour of spores.

Phillips, Manual of British Discomycetes (1887), adopts the main divisions of Saccardo's Conspectus, but adds the Gymnoascaceae. "To adhere as closely as possible to the long-accepted Friesian system has been the practice of English authors; but this has been carried a little too far, owing to our 'insular prejudices,' and the time has come when a new departure must be made. While avoiding the fondness for innovation displayed by our Teutonic, and indeed, though in a less degree, our Gallic, neighbours, I have retained in the form

of subgenera some of their more important groups." The Pezizae are divided into two series; Nudae, not clothed with hairs, and Vestitae, clothed with hairs. Boudier says of this "travail important" that it is "très clair et très facile à consulter . . . . Cet ouvrage, par sa précision, l'exactitude des descriptions et des caractères microscopiques donnés, comme par ses sous-divisions génériques simples et pratiques, est une œuvre des plus recommandables et qui a été justement appréciée comme rendant plus facile l'étude de cette famille difficile."

Massee's British Fungus Flora, Vol. IV. (1895), treats the Gymnoascaceae separately, dividing them into Ascomyceae and Gymnoasceae. The remaining families of Phillips are adopted but are arranged in the reverse order. The Pezizae are divided into three sections, Glabratae, Vestitae and Carnosae. Massee's genera are much more closely drawn than those of Phillips.

Many excellent drawings of Discomycetes are given in Bolton, Sowerby and Greville. Cooke's Mycographia deals with the Fugaces section of Fries. There are one hundred and thirteen plates, representing four hundred and six species, principally Operculeae. "Cet ouvrage mérite encore une mention spéciale et, malgré quelques points faibles, a une importance considérable parce qu'il a été fait d'après l'examen d'espèces typiques conservées dans les herbiers mycologiques et principalement dans celui de Berkeley. Par la quantité de figures données et l'indication de la mesure des spores, il a été d'une utilité incontestable, mais malheureusement beaucoup de figures ont été faites d'après des échantillons desséchés et la couleur, la forme et même les dessins des spores sont quelquefois peu conformes à la vérité. A part quelques exceptions, les espèces sont bien nommées."

In preparing this paper I have received much information from older writers, especially Paulet. Amongst modern writers I would particularly express my indebtedness to Houghton, Durand, Boudier, and Vuillemin.

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* The host of Uromyces Loti.

* *Lotus corniculatus* should have been given as the host.

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